INTERNATIONAL WORKSHOP ON READING AND DEVELOPMENTAL DYSLEXIA

¡WORDDD

MAY 30th – MAY 31st, 2013

DONOSTIA – SAN SEBASTIÁN

BASQUE COUNTRY, SPAIN
## PROGRAM SUMMARY

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Welcome to the first edition of the International Workshop on Reading and Developmental Dyslexia!

iWORDD is aimed at bringing together researchers interested in understanding the causes of developmental dyslexia and attempts to address the theoretical issues faced in this field.

Across two full days, iWORDD will feature an excellent group of invited speakers whose theoretical views will cover various hypotheses of the origin of reading disorders, and address the issue of the heterogeneity of symptoms that characterize developmental dyslexia.

This group of twelve experts will contribute to the high quality of iWORDD via an innovative format centered around six debate sessions. For each of the debates scheduled, two experts will discuss their opposed or complementary perspectives on one hot theoretical issue of great interest for the current state of the field. iWORDD will therefore offer the research community the opportunity to get a broad overview of the theories underlying research in the field, while helping outline future directions in the investigation of developmental dyslexia.

With its limited size, iWORDD will encourage interactions among invited speakers and researchers during the six debates, the four talk sessions as well as the two poster sessions scheduled over the two days.

Coupled with the aim of generating new ideas to advance our field from theoretical perspectives, the ultimate goal of iWORDD is to highlight innovative thinking which could play an important role in clinical practice and education. With this in mind, a day devoted to linking theory to practice which will be open to a broader audience will take place after the two days of scientific meeting between researchers.

We would like to express our deep gratitude to the people involved in the organization of iWORDD: Pawel Kuszelewski, Leire Arieta, Leizarbeascoa, and Sandra Atristain. In addition we would also like to thank all the research assistants and master students who will be helping during the meeting and who are a very important part of running this conference.

We hope that this first edition of the workshop in San Sebastian will just be the beginning of a long series of iWORDD meetings across the world, and that you will greatly enjoy the conference and your stay in beautiful Donostia-San Sebastián.

Marie Lallier, Nicolas Dumay and Manuel Carreiras
iWORDD organizing committee
WELCOME

ORGANIZING COMMITTEE

Marie Lallier, Nicolas Dumay & Manuel Carreiras

ACKNOWLEDGEMENTS

- We wish to thank the following sponsors for their support:
  - The University of the Basque Country – Summer Courses Committee
  - SEPEX: Spanish Society of Experimental Psychology

- We would like to thank all the researchers that have submitted their abstracts to the conference. We received 120 abstracts in all.
- Finally, we thank the Miramar Palace for their help and generosity in helping us host the conference.
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Results and non-results in the neuroimaging of dyslexia

Franck Ramus
CNRS - Laboratoire de Sciences Cognitives et Psycholinguistique, Institute of Cognitive Studies, Ecole Normale Supérieure, Paris, France

I will report findings from structural MRI analyses carried out on the brain images of a population of 32 dyslexic and 32 control children, as well as on separate groups of dyslexic and control children scanned by collaborators. Our analyses bear on gray matter volumes, cortical thickness, sulcal configurations (of the sylvian fissure and the central sulcus), dimensions and asymmetry of the planum temporale and of Heschl's gyrus, and the micro-structure of the arcuate fasciculus. I will also highlight all the effects published in the dyslexia literature that we have failed to replicate on the way to our results. I will then reflect on the limitations of most published studies, on the conditions necessary to produce replicable results, and on the importance of oft-overlooked variables such as age, sex, SES and IQ.

Heinz Wimmer
University of Salzburg, Austria

My contribution will examine the evidence for the position that the main hurdle for dyslexic children is to acquire self-reliant phonological word decoding in the early phase of learning to read and that this difficulty with phonological reading secondarily leads to deficient input to the visual orthographic word lexicon required for fast visual word recognition (and for correct spelling). In neurological terms, the primary phonological reading problem is attributed to a dysfunction of a left temporo-parietal brain region; the secondary orthographic deficit is seen as reflected in reduced engagement of a left ventral occipito-temporal region. In the examination of this account, imaging studies and meta-analyses from our lab will be presented and a revision of the theoretical account will be proposed.
The nature of the visual deficits in developmental dyslexia

Causal connections between multi-sensory attention and learning to read

Andrea Facoetti

Developmental & Cognitive Neuroscience Lab, General Psychology Department, University of Padova, Italy
Developmental Neuropsychology Unit, "E. Medea" Scientific Institute, Bosisio Parini, Lecco, Italy

Although impaired phonological processing is assumed to characterize dyslexic individuals, emerging evidence suggests that dyslexia could arise from a more basic cross-modal letter-to-speech sound integration deficit. Before the correct letter-to-speech sound integration is applied, letters have to be precisely selected from cluttering letters and global spoken word have to be segmented in their speech-sound units by efficient orienting of visual and auditory attention, respectively. Spatial attention deficits in children with dyslexia might impair their ability to focus on each successive letter in a visual word, and an extra-large letter spacing could help reading in dyslexic children. We showed that this simple manipulation of letter spacing substantially improved text reading efficiency on the fly (without any training) in a large, unselected sample of Italian and French dyslexic children. We demonstrated that only 12 hours of playing action video games—not involving any direct phonological or orthographic training—drastically improve the reading abilities of children with dyslexia. Action video games training could improve the efficiency of the Magnocellular-Dorsal pathway, because only action video games require an extraordinary speed in terms of transient events and moving objects, and an emphasis on peripheral processing. To test this prediction, we measured text reading and attentional skills in two matched groups of adult poor readers before and after a motion perceptual learning or an active control training. We found that only the group treded with 20 hours motion perceptual learning improved their reading abilities. Attentional skills also improved during Magnocellular-Dorsal pathway training. These results showed that dorsal-attention pathway improvement can directly translate into better reading abilities, providing a new and fast remediation of dyslexia. Importantly, we showed that pre-reading visual and auditory attentional orienting (assessed by spatial cueing facilitation and temporal order judgment), in addition to speech-sound processing, and cross-modal mapping, captures about 60% of the future reading acquisition skills. All these results demonstrate the causal role of multi-sensory selective attention in reading acquisition, and suggest new approaches for early identification and efficient prevention of dyslexia.
The nature of the visual deficits in developmental dyslexia

A neural framework for impairment in visual attention being a core deficit in developmental dyslexia

Trichur Vidyasagar

Department of Optometry & Vision Sciences and Melbourne Neurosciences Institute, University of Melbourne, Australia

Reading is a relatively recent activity in the history of Homo sapiens. It almost certainly uses neural mechanisms, which had already evolved over many hundreds of millennia for a different purpose. What may these be? It is becoming apparent that a crucial stage in reading are visual attentional mechanisms that usually help us to select and process only that small fraction of sensory information which is relevant at a particular instant, from among a world of ‘noisy’ sensory inputs. A careful consideration of all the known neural pathways needed for reading a text opens up the possibility that the core deficit could be at any one of a number of stages in the visual system that apply the above process of attentional selection to reading. The cortical region that orchestrates such selective attention is the posterior parietal cortex, which seems to direct a spotlight of attention on to earlier visual areas. Such gating of sensory inputs rapidly and at a fine spatial scale by the feedback pathways from the dorsal stream to earlier visual areas is a fundamental process in reading and any deficit in this process can potentially lead to poor reading abilities. Such deficit could be either in the visual magnocellular inputs that project to the dorsal stream or in the dorsal stream areas themselves. It is also conceivable that even the severe phonological impairments commonly associated with dyslexia could at least partially, if not totally, be a simple downstream consequence of the deficit in visuo-spatial attention. However, there is also the possibility that a general impairment in spatio-temporal processing of sensory information could lead to both the visuo-spatial and phonological difficulties and the dyslexic symptoms may often have a multifactorial cause.
Speech perception problems as a risk factor for dyslexia: Phonemic and allophonic processing perspectives

Speech perception problems as a risk factor for dyslexia

Paavo H. T. Leppänen

Department of Psychology, University of Jyväskylä, Finland

The role of dysfunctional neurocognitive processes for dyslexia and their interaction with phonological problems, one of the major underlying factors for dyslexia, still remain unclear. Several behavioral and brain response studies suggest that a link could be atypical speech perception. Event-related potential (ERP) findings from two large scale longitudinal studies (Jyväskylä Longitudinal Study of Dyslexia, JLD, Finland, and Dutch Dyslexia Programme) show that infant brain responses to speech sounds are related to familial risk for dyslexia and also predict later reading skills at school-age. For example, dyslexic children participating in JLD, who were diagnosed at school-age and had a familial risk background, had atypical processing of various sound features already at birth and at the age of six months. Infant brain responses also correlated to childhood language and pre-school age reading related skills, and reading and writing skills at school age. Atypical brain activation also persisted in development until pre-school and school age. Speech perception at the behavioral level also continued to differ between dyslexic and typical readers. Further, long term phonemic representations, as measured by the mismatch negativity (MMN) brain response, appear to be atypical in school-aged children for a native speech sounds in a large scale European cross-linguistic ERP-study (a part of Neurodys). Such findings, overall, suggest that speech perception may have cascading effects on later linguistic and phonological skills and consequently on dyslexia. However, evidence also shows that not all individuals with dyslexia have problems with speech perception or atypical responses to native speech sounds. This suggests that problems in speech perception are not likely alone a sufficient reason for developmental dyslexia, but rather one endophenotype /risk factor.
Speech perception problems as a risk factor for dyslexia: Phonemic and allophonic processing perspectives

Allophonic theory of dyslexia: Recent developments and perspectives

Willy Serniclaes

CNRS, Laboratoire de Psychologie de la Perception, U. Paris Descartes
Unité de Neurosciences Cognitive, U. Libre de Bruxelles

Evidence from a wide range of studies indicates that individuals with dyslexia have a phonological deficit. The phonological problems experienced by dyslexics have initially been related to the access to phonemic representations but they are now more and more frequently attributed to the perceptual processing of phonemes. However, the very nature of the phonemic deficit in dyslexia remains debated. One of the questions raised is whether dyslexics have merely a lower acuity in phoneme perception or, more radically, whether they do not use phonemes for perceiving speech. This last possibility has been formalized in the framework of allophonic theory. Normally, the universal predispositions for perceiving speech are adapted to the phonemes of the environmental language during the first year of life. According to allophonic theory, dyslexic people do not adapt these predispositions to their native language. Consequently, they segment speech sounds into universal “allophonic” segments that do not correspond to language-specific phonemes. In support to this theory, behavioral and brain studies conducted in different languages (French, Dutch, Spanish) suggest that dyslexics present an over-discrimination of allophonic features, different from the language-specific phonemic features. Also, convergent evidence from behavioral and brain data indicates that dyslexics have a better acuity in the perception of subphonemic segments than typical readers, that might be related to an oversampling at some cortical time scales. Finally, intervention studies conducted in different laboratories point to possible impact of remediation of allophonic perception on reading performances. However, several questions remain. For example, over-discrimination of allophonic features by dyslexic people has not been found in all behavioral studies. However, other studies consistently found that when the dyslexics’ allophonic sensitivity was absent from their behavioral responses it was still present at the neural level. This raises different questions about alternative neural pathways for accessing to phoneme perception and their possible exploitation in remediation assays.
A phonological deficit or a broader auditory deficit as a core impairment of dyslexia?

Auditory working memory as an underlying deficit in dyslexia

Merav Ahissar

Department of Psychology, Faculty of Social Sciences - The Hebrew University of Jerusalem. Israel

A typical characteristic of Dyslexic individuals is their poor working memory. Though mainly studied in the verbal domain (e.g. Digit span), auditory working memory was found to be systematically impaired in Dyslexia across stimulus types. We previously suggested the “anchoring deficit” which proposes that implicit aspects of working memory, which track regularities in incoming auditory stimuli, are impaired in Dyslexia (Ahissar et al., Nat Neurosci, 2006; Ahissar, TICS, 2007). This hypothesis explains Dyslexics’ difficulties in acquiring efficient reading as stemming from difficulties in detecting the repeated underlying phonological patterns that characterize their language. Consequently, they need to actually “read”, i.e. map the orthography to phonology, rather than retrieve only few reliable cues, as expert readers do. This hypothesis further explains Dyslexics’ additional difficulties, e.g. poor performance in auditory discrimination tasks, as revealing a failure to utilize regularities in the sequence of auditory stimuli which typically facilitates perceptual performance (Oganian & Ahissar, 2012). We recently developed a computational model that dissociates between sensory noise and the contribution of recent history (working memory) in discrimination tasks (Raviv, Ahissar & Loewenstein, 2012). We indeed found that Dyslexics differ in their reduced weighting of recent history rather than in their increased sensory noise. The existence of Dyslexic musicians seems to challenge this auditory-general view, since musicians are known as very sensitive to sounds, and as having enhanced auditory working memory. We tested this population and found that even Dyslexic musicians have difficulties in non-verbal auditory memory (e.g. memory for pitch and for rhythm) compared with their peers. Moreover, their non-verbal auditory working memory is mainly impaired in its chunking ability, suggesting reduced ability to utilize regularities. Their working memory was a reliable predictor of their reading accuracy, as previously found for other dyslexic populations.
A phonological deficit or a broader auditory deficit as a core impairment of dyslexia?

Temporal auditory processing and speech perception as possible underlying deficits of the phonological problems in persons with dyslexia

Pol Ghesquière

Humanities and Social Sciences at Katholieke Universiteit Leuven, Belgium

Mapping graphemes to phonemes (the essence of reading) builds upon phonological awareness of the child, i.e. the consciousness of the sound structure of spoken language and the skill to manipulate it. Preschool children manipulate speech mainly at the syllable level. Only during reading acquisition phoneme awareness emerges and explicit phoneme representations develop. However, in order to develop clear phonological representations at syllable and phoneme level, the auditory system must be able to accurately process dynamic acoustic cues that are crucial for speech perception. Because of the importance of auditory sensitivity in reading acquisition, auditory processing and speech perception skills have received increasing attention in relation to dyslexia. Yet, only little evidence exists on the causal influence of these skills on reading development and on their specific nature. Therefore in 2003, we started a longitudinal project starting before the formal instruction of reading until the end of primary school. This project demonstrated that children with dyslexia have pre-reading deficits in auditory processing, speech perception and phonology, but more importantly, that basal auditory temporal processing and speech perception in kindergarten uniquely contribute to growth in reading ability. This is the first study that demonstrates that auditory processing and speech perception impairments in dyslexia are not merely an epiphenomenon of reading failure but that they precede and possibly contribute to the reading development. In a second cross-sectional project, involving 12-year-olds and adults diagnosed with dyslexia, we further investigated the precise nature of their auditory and speech perception problems. More specifically, by applying a balanced design we investigated whether the deficit is specific to speech and/or specific to temporal processing. Results show that both 12-year-olds and adults with dyslexia have an auditory temporal processing deficit which is not speech-specific.
The phonological deficit: Cause or consequence of reading disorders?

Anne Castles

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The phonological core deficit hypothesis of dyslexia has dominated research in the field for several decades. In its strongest form, this hypothesis can be seen as reflecting three associated claims: a) that there is only one basic kind of dyslexia, b) that all (or at least the vast majority of) dyslexic children have phonological impairments, and c) that these phonological impairments cause their dyslexia. In this talk, I examine each of these claims in turn and consider evidence both for and against them. I conclude that, although it is clear that many dyslexics perform poorly on tasks designed to tap phonological skills, there is much still to be learned about why this is the case and what the nature of the relationship is between phonological abilities and reading. Evidence from precise and targeted studies is required to untangle the complex pattern of relationships observed.

Kate Nation

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As noted by Anne Castles, the phonological core deficit hypothesis of dyslexia has dominated research in the field for several decades. Throughout this time, it has also become well-established that learning to read an alphabetic orthography fundamentally changes phonological processing. Although debate continues as to how this might happen, the finding that it does happen has implications for the phonological deficit hypothesis of dyslexia. I will draw on a range of studies to discuss these implications and in doing so, consider the nature of the relationship between phonological skills and learning to read, both in typical development and in children with developmental dyslexia.
Are there subtypes of developmental dyslexia?

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Although there has been significant progress in our understanding of the cognitive architecture that underpins the development of both normal and atypical literacy skills, our knowledge about the nature of developmental dyslexia remains much less advanced. As developmental dyslexia is characterised by a diverse constellation of symptoms, it seems natural to ask whether the underlying risk and protective factors aggregate into subtypes of individuals or not and this is currently an active area of research. To date, this pursuit has been most successful in identifying clusters of individuals with presumed dissociations between specific components of reading, consistent with two theoretical approaches: the dual route model and the double deficit hypotheses. Both models predict the occurrence of discrete subtypes of individuals, with relatively isolated deficits in a single component process and comparatively normal functioning in the other. Each approach has reported subtypes of dyslexia that are largely consistent with its own theoretical perspective. The evidence for these subtypes largely derives from measuring the proportion of individuals who score below some arbitrary threshold on one or both of two theoretically relevant cognitive tasks. However, defined in this way, any continuous bivariate distribution will reveal individuals with single or combined deficits and the proportion in each category that will arise by chance can be estimated through straightforward statistical modelling. Applying these estimates to published data on dyslexia subtypes suggests that the frequencies observed in each group in empirical studies often fail to differ significantly from what would be expected by chance. This provides a powerful challenge to the use of this simple dissociation logic in this context and suggests that stronger evidence is required in order to reify the existence of distinct diagnostic entities from such data.
Are there subtypes of developmental dyslexia?

Sylviane Valdois

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Evidence for developmental dyslexia subtypes requires that groups of dyslexic children can be identified, each showing a different underlying cognitive disorder and a different neurobiological dysfunction. Thus, relevant subgroups have to be cognitively homogeneous. However, none of the classical reading-based subgroups (phonological vs. surface dyslexia) or the double deficit hypothesis guarantees the homogeneity assumption. In the same way, while cluster analysis may identify statistically reliable subtypes, these subtypes are not necessarily theoretically relevant. Thus even the powerful multivariate method faces with the key problem of distinguishing causal factors from associated ones. Assuming that single-case studies may provide relevant information, we carried out in depth investigation of single cases with no phonological disorder. Such investigation showed evidence for a multiple-element parallel processing disorder --i.e. a visual attention (VA) span disorder-- that was viewed as a potential candidate to account for a second non-phonological subtype of developmental dyslexia. Subsequent group studies revealed that phonological and VA span disorders typically dissociate in the dyslexic population AND are independent predictors of reading performance in both dyslexic and typical readers. The overall findings thus suggest the existence of at least two subgroups of dyslexic children: a phonologically impaired subgroup and a VA span impaired subgroup. Because subgroups have to be defined at the cognitive AND neurobiological level, we explored the neural underpinnings of the VA span disorder. Results suggest that the double dissociation found at the cognitive level is mirrored by a neurobiological dissociation. Whereas the phonological subtype relates to a left hemisphere perisylvian dysfunction, the VA span subtype is associated with a bilateral superior parietal lobule dysfunction. Evidence for two phonological and VA span subtypes is further supported by the multi-trace memory model which specifies how these two cognitive processes interact to produce skilled reading. Further research is needed to investigate the genetic bases of these two disorders.
Generalisation of untrained irregular words in spelling

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Previous spelling intervention studies have found improvements for untrained irregular words (i.e., generalisation). However it is unclear which words are most likely to improve and which mechanisms drive this generalisation. We conducted a case-series intervention study with children who have developmental spelling difficulties (surface dysgraphia) to examine whether: (1) generalisation occurs for orthographic neighbours of trained words; (2) generalisation is facilitated by large neighbourhood size; or by (3) overall high frequency; and whether (4) generalisation is more likely to occur for words whose spelling, while imperfect, is somewhat known prior to training. The training (direct and delayed copying) was completed by 11 children and led to significant improvements in spelling for all participants. Most children (N=7) showed generalisation for untrained words. On average, the group of children improved significantly in spelling untrained neighbours (e.g., rough) of trained words (e.g., dough), while untrained non-neighbours matched for frequency and length did not improve. This pattern was also shown by three individual children. Group analysis revealed significant improvements for untrained words high in both neighbourhood size and frequency, but words that were high in either frequency or neighbourhood size did not yield significant improvements. This pattern was not significant for any individual. For all children, the closer that the pre-training misspelling was to the correct spelling (e.g., rouf vs rufe for rough) the greater the likelihood of generalisation for that word. This case-series provides further evidence that generalisation of improvement from treated to untreated irregular words in spelling is a relatively common, albeit small, effect across participants. The results show that neighbourhood plays an important role in generalisation supporting Sage and Ellis’ theory that generalisation occurs due to co-activation of orthographically similar words and that this only occurs for words that already have a (rather than no) representation in the orthographic lexicon.
Behavioural and electrophysiological changes after an intensive visual-orthographic and auditory-phonological remediation program in developmental dyslexia

Jucla, M.¹,², Chaix, Y.³,⁴,⁵ & Démonet, J.⁶

Evidence-based intervention studies in developmental dyslexia usually aim at evaluating the outcomes of one specific skill training (for instance phonemic-grapheme mapping or visual attention) compared to more general reading exercises. In this presentation, our objective is to give an overview of the main results of a longitudinal study we conducted in 30, 9 to 11 years old, children with dyslexia. In France, those children barely benefit from special education in schools but are instead treated by language therapists in a once or twice a week basis. It is well known that intensive training is one of the main keys to reading improvement. We have therefore evaluated the effects of a 4-months intensive daily programme based on i) phonemic awareness (PA) and ii) visual attention (VA) training. All children received both training modalities in a cross over design. We tested them on written and oral language, short-term memory, and visual attention span before, between and after the training phases. During the same sessions, we recorded electrophysiological changes using visual and auditory lexical decision tasks and a rhyming judgment task. We also measured the mismatch negativity during a passive syllable listening with changes occurring at the acoustic or phonological level. Three main points arose from the different results we obtained. 1) As expected, targeted skills (PA and VA) were specifically improved by specific training with an even greater benefit for children impaired in these domains. ERP correlates of these effects were found for the rhyming task. 2) Reading performance increased after the whole programme without interaction with training modality (long-lasting effects were shown 6 months after the intensive training). 3) According to ERP results in the lexical decision task, better word identification was associated with a P300 decrease suggesting reading improvement could be related to a diminution of the cognitive load.
A behavioural and ERP investigation of letter-sound processing: Is a lack of automaticity a proximal cause of dyslexia?

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Drawing on evidence from neuroimaging studies Blomert proposed that the proximal cause of dyslexia is a deficit in forming automatic connections between letters and phonemes. Using fMRI Blau et al, (2009; 2010) found reduced integration of letter-phoneme pairs in dyslexics and using the cross-modal MMN the same research group found evidence for integration in adults and older children but not in younger or dyslexic children (Froyen et al, 2008; 2009; 2010). In a pilot study we collected data from developing and more advanced readers using a priming task in which we compared targets in related (prime was the same letter/phoneme) and unrelated (neutral prime) conditions. We conducted two experiments, in the first a letter prime preceded a phoneme target and in the second the phoneme was the prime and the letter the target. We found that both groups were faster to respond to the target in the related condition, at both a long (500ms) and short (0ms) ISI. Therefore, exposure to a letter/phoneme facilitated the subsequent processing of the same phoneme/letter, suggesting that the two representations are integrated. In addition, we found that priming from letters-to-phonemes was a predictor of decoding. In the main study we collected behavioural and EEG data from dyslexic children, age-matched and reading-matched controls. In the behavioural experiments we found that children in all 3 groups showed evidence of integration. However, preliminary analyses of ERPs suggested group differences. The age-matched controls showed an effect of related letters on phonemes in the central region and an effect of related phonemes on letters in the left parietal region, but these effects were weaker in the dyslexics and reading-matched controls. There was some evidence of an effect emerging later in the latter 2 groups, possibly reflecting differences in latency or the role of attentional processing.
The manifestation of visual attention span deficit in English-speakers with compensated dyslexia: A fMRI study

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This study examines the neural correlates of visual attention span (VAS) in native English-speaking university students with compensated dyslexia and their controls, using fMRI. Previous fMRI studies with French-speaking children and adults conducted by Valdois and her colleagues have shown the importance of VAS in skilled reading, where the neural correlates of VAS were associated with activation in the left superior and inferior parietal cortex. Valdois’s team further reported that reduced activation has been observed in these regions in French dyslexics with VAS disorder. In this study, native English university students and graduates performed a visual letter/shape categorisation task previously used with French participants. Similar to previous behavioural findings, these dyslexics were significantly slower in performing the task, but similarly accurate as the controls. Moreover under fMRI both groups activated the left inferior and superior parietal cortex. However, these compensated dyslexics showed greater activation relative to controls within the parietal cortex, and further revealed activation within bilateral frontal and occipito-temporal regions which were not seen in the controls. This *uneconomical* use of neural resources may underlie compensatory strategies used by these English dyslexics, in order to perform the task as accurately as controls, albeit considerably slower.
No deficiency in left-to-right processing of words in dyslexia but evidence for enhanced visual crowding

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Whitney and Cornelissen (2005) hypothesized that dyslexia may be the result of problems with the left-to-right processing of words, particularly in the part of the word between the word beginning and the reader’s fixation position. To test this hypothesis, we tachistoscopically presented consonant trigrams in the left and the right visual field (LVF, RVF) to 20 undergraduate students with dyslexia and 20 matched controls. The trigrams were presented at different locations (from -2.5° to +2.5°) in both visual half fields. Participants were asked to identify the letters and accuracy rates were compared. In line with the predictions of the SERIOL model of visual word recognition (Whitney (2001), a typical U-shaped pattern was found at all retinal locations. Accuracy also decreased the further away the stimulus was from the fixation location, with a steeper decrease in the LVF than in the RVF. Contrary to the hypothesis, the students with dyslexia showed the same pattern of results as the control participants, also in the LVF, apart from a slightly lower accuracy rate, particularly for the central letter. The latter is in line with the possibility of enhanced crowding in dyslexia. In addition, in the dyslexia group but not in the control group the degree of crowding correlated significantly with the students’ word reading scores. These findings suggest that lateral inhibition between letters is associated with word reading performance in students with dyslexia.
Does viotin activate violin more than viocín? On the use of visual cues during visual-word recognition

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The vast majority of neural and computational models assume that visual-word recognition in adult skilled readers is achieved via the activation of abstract letter identities. In the present lexical decision experiment, we compared word-like pseudowords like viotin (same outline shape as its base word: violin) vs. viocín (different outline shape) in mature (college-aged skilled readers), immature (young normally developing readers), and immature/impaired (young readers with developmental dyslexia) word-recognition systems. Consistent with current neural/computational models of visual-word recognition, results revealed similar response times (and error rates) to viotín-like pseudowords and viocín-like pseudowords for both adult skilled readers and young normal readers. In contrast, young readers with developmental dyslexia made significantly more errors to viotín-like pseudowords than to viocín-like pseudowords. Thus, unlike young normally developing readers, young readers with developmental dyslexia are sensitive to a word’s visual cues—presumably because of poor letter representations.
Anchoring - a domain general factor in preschool oral and written language

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The role of domain general factors in the development of oral and written language in the preschool years is not well understood, but neuroconstructivist approaches to cognitive development suggest that the contribution of domain-general factors should be more salient prior to the acquisition of domain-specific knowledge in each domain. We have previously shown that anchoring, defined as the ability to implicitly use contextual information to facilitate perception, significantly contributes to rapid naming and phonological memory skills of preschool children. Furthermore, anchoring in those two tasks accounts for significant variance in indices of early reading (letter knowledge and phonological awareness). In the current study the hypothesis that anchoring is a domain general process was tested. To that end, the effects of anchoring were estimated in both a verbal task (phonological awareness) and a non-verbal task (visual size identification). Anchoring effects were evident in both cases. In the verbal task, children identified the initial sounds of words more accurately if all words on the list shared the same word form, thus affording anchoring, than in a condition in which words had different word forms. Likewise, in the visual task, children were faster to identify large shapes when the variety of shapes presented in a series was small than in a condition with a larger variety of shapes, even though shape identity was task irrelevant. The magnitude of the anchoring effects was correlated between the verbal and visual tasks. Furthermore, anchoring in the visual, non-verbal task accounted for unique variance in language tasks (phonological awareness and vocabulary). In conclusion, anchoring appears to be a domain general factor that contributes to both oral language and early reading in the preschool years. Whether the contribution of anchoring diminishes once domain-specific reading-related knowledge is acquired remains to be determined in future studies.
Non-word reading and repetition predicts auditory perceptual anchoring in dyslexia

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We investigated auditory perceptual anchoring in dyslexia using a frequency discrimination (FD) task, as described by Ahissar et al. (2006, Nature Neuroscience, doi:10.1038/nn1800). We recruited 24 6- to 13-year-old children whose accuracy for reading regular words, irregular words, or non-words fell below the average range for their age. We also recruited 19 children with age-appropriate regular, irregular, and non-words reading accuracy (controls). In two FD conditions, children were presented with two tones between 1000 and 1500 Hz and asked to judge whether the first or second tone was higher in pitch. In the ?standard? condition one of the two tones was always 1000 Hz. In the ?no standard? condition, one tone was randomly chosen between 1000 and 1400 Hz. Previous work by Ahissar et al. (2006) has demonstrated that controls produce poorer (i.e., higher) thresholds in the ?no standard? condition than the ?standard? condition. In contrast, children with dyslexia perform equally poorly in both conditions. In this study, our group analysis replicated this effect. However, analysis of the individual data revealed two subgroups within the dyslexia group. The largest subgroup produced poor thresholds in both the ?standard? and ?no standard? condition. In contrast, a smaller subgroup performed well in the ?standard? condition and very poorly in the ?no standard? condition. Further comparison of these subgroups revealed that the smaller subgroup group had performed significantly better on language measures (non-word repetition and recalling sentences). A regression analysis within the dyslexia group revealed that non-word repetition and poor non-word reading significantly predicted ?standard? FD thresholds. Considered together, these findings suggest that only a subgroup of children with dyslexia have perceptual anchoring deficits, and these children tend to perform poorly on reading, language, and psychoacoustic tasks that tax the ability to reproduce the order of sounds.
Dyslexia as a dis-order: The SOLID hypothesis

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The present paper introduces the SOLID (Serial-Order Learning Impairment in Dyslexia) hypothesis. This novel hypothesis provides an integrative account of dyslexia: it reconciles the dominant theoretical views under the assumption that dyslexia and its variety of related linguistic and nonlinguistic dysfunctions may be traced back to a central, specific impairment of serial-order learning. The SOLID hypothesis is supported by a triple-session experiment in which participants with dyslexia and matched controls memorized sequences of syllables through a Hebb repetition protocol. Memorization and lexical engagement of the repeated sequences was tested immediately, 24h, and one month after Hebb learning. Our results demonstrate that people with dyslexia are fundamentally impaired in the acquisition of serial-order information, leading to impoverished lexical representations.
The speech-in-noise comprehension deficit in dyslexia: Behavioral and cortical fingerprints

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Although people with developmental dyslexia are characterized by normal oral language skills in quiet environments or favorable listening situations, they show clear speech-comprehension difficulties as soon as this task is made more complicated. In conditions of cognitive load or when the listening situation is made less favorable by the addition of external noise for example, people with dyslexia show a reproducible and life-time lasting deficit that could relate to a subjacent phonological deficit. In the current paper we will review data from multiple studies that were run in our group in order to characterize this deficit both in terms of behavioral and cerebral correlates. On the behavioral side, we will first show how the informational content of the interfering sound strongly modulates this deficit. In particular, we will discuss the fact that concurrent speech compared to any other types of non-speech or speech-derived noises constitutes the most difficult masker for dyslexics who seem to be especially sensitive to the informational component of masking phenomena. We will then display a series of measures testing different listening configurations that show that dyslexics exhibit normal binaural listening abilities and are able to perform binaural unmasking of speech-in-speech. This result suggests that binaural listening abilities are not the cause of the deficit. We will then discuss different aspects of the speech-in-speech situation where we manipulated psycholinguistic dimensions of both target- and interfering-words as the lexical frequency or the size of the phonological neighborhood to show that inside the informational masking compound, the phonological level seems to play a crucial role in dyslexics’ difficulties. Finally we will mention recent neuroimaging evidence including functional (fMRI) and morphological (VBM) data supporting the idea that one of the cortical correlates of dyslexia is an abnormal asymmetrisation of certain speech-processing areas.
Impaired audiovisual speech processing in dyslexia

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In search of a psycholinguistic theory that might explain the origin of the phonological deficit - generally believed to be the cause of dyslexia - we have created an experimental paradigm that allows us to test subjects' abilities to process phonological stimuli in visual- only, acoustic- only and audiovisual conditions. The aim of the study was to examine the perception of audiovisual speech in adolescent/adult dyslexics and detect correlations between deficient audiovisual and deficient phonological processing. Based on current models of audiovisual speech processing, we provide a conceptual and analytical framework of bimodal speech perception able to explain such correlations. Subjects/controls (n=50) were tested with standardized dyslexia tests. Eye movements were tracked while they had to a) visually identify syllables and target words (lip-readable stimuli), b) process audiovisually congruent and incongruent stimuli (McGurk stimuli, both with syllables and words) from a talking face and c) read out pseudowords aloud. The acoustic-only conditions consisted of a syllable/word/pseudoword repetition task. We obtained data from our dyslexic subjects that supported our assumption that the McGurk effect cannot be as robustly triggered as in controls. The eye-movement analysis focussed on lip-readable areas of interest (AOIs) in the talking faces (conditions a and b) and the cumulative fixation duration within the AOIs. The pseudoword reading task (c) was analysed according to fixation duration, cumulative fixation duration and regressions within words. Subjects performed poorest in the pseudoword reading task, resulting in significantly longer cumulative fixation durations and regressions within words (which did not occur in controls). No significant differences were found in the audio- only and visual- only task. We interpret non- susceptibility to the McGurk effect and the difficulty with the pseudoword reading task as multimodal integration deficits occurring in audiovisual speech integration tasks as well as in a grapheme- phoneme 'translation' tasks.
Facial speech gestures: The relation between visual speech processing and dyslexia in 10-year-olds

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Successful communication in everyday life crucially involves auditory and visual components of speech. Viewing our interlocutor facilitates speech perception by triggering auditory processing, even before the auditory input is fully received. The causal role of auditory speech perception in developmental dyslexia has been widely discussed, revealing deficits in phoneme discrimination. However, visual aspects of phoneme perception have not been investigated in dyslexics. The present study addresses this issue in school children with and without writing problems, using a passive visual oddball paradigm with facial speech gestures silently producing the phonemes /pa/ and /ga/. Our results reveal that normally developing children discriminate these facial gestures, showing a positivity with an occipital distribution in response to the infrequent gestures in the experiment. Interestingly, children with writing problems also show a positivity as discrimination response, however, with an anterior distribution. These results indicate qualitative processing differences between children with writing problems and their normally developing peers for visual features of phoneme perception. The different distributions of discrimination responses across groups suggest that children without writing problems recruit occipital regions typically involved in visual processing. In contrast, children with writing problems seem to rely on anterior regions, possibly engaging fine-grained articulatory or subvocal processes as compensatory processes. Further investigations need to show whether such compensatory mechanisms support the insufficient auditory speech-related phonological representations in individuals with developmental dyslexia.
The Bergen Longitudinal Dyslexia Study

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Introduction. The aims of this study were to identify and follow up five-year-olds at risk of developmental dyslexia focusing on five areas: 1) pre-literate detection, 2) pre-literate training using a Bottom up (BU) and a Top down (TD) data-based training method, 3) neurocognitive development, 4) gender and heredity, 5) brain imaging (fMRI) at ages 6 (pre-literate phase), 8 and 12 (literate phases). Method. Parents and teachers of 109 five-year-old children (55 boys and 54 girls) from randomly selected districts in Norway answered a Risk Index questionnaire (RI-5) on soma, health, motor development, language development, need for special education, and heredity. 25 children were defined as at-risk. Together with 24 matched controls they were regularly assessed until they were twelve years old. The following is an overview of the main findings. Findings. 1) 13 children (11 at-risk, 2 controls) were identified as dyslexic when they were eleven years old; 2) data based training using both a TD and a BU training method showed significant effects; neurocognitive deficits seen in the dyslexia group before school age decreased by age; 3) the dyslexia group consisted of 5 boys and 8 girls with no statistical gender difference in literacy or IQ-scores; 4) for all boys (100%), but for only three (37.5%) of the girls, language problems and/or dyslexia in close biological family were reported; 5) Both pre- and post-literate fMRI showed evidence of diverging brain responses in the dyslexia group. Conclusions. We conclude that 1) the RI-5 questionnaire has predictive value, 2) early data based intervention combining a BU and a TD method has an effect, 3) neurocognitive deficits in dyslexia ameliorate by age, 4) dyslexia is equally distributed across genders, but with different gender etiologies, 5) diverging brain responses can be seen already in the pre-literate phase.
Effects of task complexity on neural activity in children with dyslexia

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This study aimed to investigate brain activity in children with and without dyslexia while reading words and sentences with increasing linguistic and orthographic complexity. In earlier studies the caudate nucleus has been implicated in language comprehension and silent articulatory processes, whereas the anterior cingulate has been tied to reading comprehension and attention. Examining how reading complexity impacts brain activity in children has, however, to our knowledge, not been done previously. Twenty-nine 11-year-old children were recruited through The Bergen Longitudinal Dyslexia Study?. After literacy assessment, a dyslexia group (DYS: N=11, 5 male, 6 female) and a typical group (TYP: N=18, 10 male, 8 female) were identified. The children were assessed using block design fMRI. Stimuli were presented visually in three runs with three conditions representing different levels of complexity (C1: alphabetical, C2: orthographic, C3: sentences). Data were first subjected to factorial analysis. Second, regions showing an interaction effect of group by task were selected for regions of interest (ROI) analysis. Tukey HSD for unequal N was used as follow-up. Finally, t-tests were performed to further investigate group differences. The factorial analysis returned three main areas with a significant interaction effect of group by task; left anterior cingulate (LACC), left caudate nucleus (LCN) and the right anterior cingulate towards the medial frontal gyrus (RACC). The ROI showed that all three areas responded to increased complexity with up-regulation of neuronal activity in the DYS group, and down-regulation in the TYP group. Post-hoc testing indicated that the interaction was mainly driven by the sentence condition. T-tests showed significant group differences on C1 (LACC and LNC, DYS<TYP, p<.04) and C3 (all three regions, DYS>TYP, p<.04). These findings suggest that areas associated with substrates of language processing may show opposite patterns of neuronal activity in children with and without dyslexia when reading increasingly complex stimuli.
Predictors of developmental dyslexia in Spanish school children: A longitudinal study

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The relationship between phoneme awareness, rapid automatized naming (RAN), verbal short-term memory (V/STM) and diagnostic category is investigated in control and dyslexic children. Phonological and literacy skills were tested in 109 control and 102 dyslexic children from two schools levels, 2nd and 4th grade. Literacy skills were tested a second time, two years later. Literacy skills tests included a reading word test and a reading pseudoword test, a pseudohomophones decision task and a dictation test. In the first phase, dyslexics showed difficulties in the three phonological processes. Phoneme deletion was the strongest predictors of developmental dyslexia, while V/STM and RAN played a comparatively minor role. RAN test showed stronger relationship with speed measures than with accuracy ones. Phoneme deletion diminished its predictor value in the higher grade, while RAN did not lose prediction value. The second phase is still processing but results will be reported.
Development of the reading network in children with high-risk on
dyslexia: Results of the first wave of a longitudinal study

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It is generally accepted that the reading problems in persons with dyslexia are
caused by a deficit in the development and the use of phonological
representations. However, little is known about how the neural reading network
develops, especially in relation to dyslexia. Previous fMRI studies demonstrate that
persons with dyslexia fail to produce the typical pattern of widespread left
lateralised activation that reading elicits. Given that these regions are distant,
examination of their connections is vital to understand the causes of
underactivation. In the current longitudinal study the neural connections of
reading-related areas in pre-reading children (last year of kindergarten) and in
beginning readers (2th grade) will be examined using two neuroimaging
techniques: DTI (indicating structural connectivity) and Resting-state fMRI
(indicating functional connectivity). We scanned 40 pre-reading children with a
family risk for dyslexia and 35 control children. The high-risk group (HR) consists of
children with at least one first-degree relative with a formal dyslexia diagnosis. The
control group (LR) is individually matched based on age, gender, nonverbal
intelligence and educational environment. Also cognitive data were collected,
including pre-reading phonological and orthographic skills. At the moment of the
conference, DTI-data of the first (pre-reading) wave will be analyzed. The bilateral
arcuate fasciculus (AF) and the left inferior fronto-occipital fasciculus (IFOF) will be
delineated. We will be able to make conclusions on whether (1) in line with our
previous adult study (Vandermosten et al., Brain, 2012) relations of fractional
anisotropy (FA) in AF with phonology and in IFOF with orthography can be
replicated in preschoolers, and whether (2) a white matter deficit in left AF can be
found for the children at risk for dyslexia. This study strives to contribute to the
discovery of specific neurophysiologic markers for dyslexia, important for the early
detection of this specific learning ability.
Present and past: How the infant Mismatch Negativity can predict written language abilities in 10-year-olds

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The Mismatch negativity (MMN) of the event-related potential is a strong tool for investigating auditory processing, especially given its re-test reliability. Since auditory processing abilities can be viewed as prerequisites for successful language development, the infant MMN might suit as an early diagnostic measure for later reading and writing abilities. The present study retrospectively investigates the MMN of school children with and without writing problems, who were previously tested at the age of five months. At both ages, children were presented with a passive oddball paradigm, investigating their ability of phoneme discrimination. As expected, for 10-year-old children with written language problems at school results reveal diminished MMN responses to deviant phonemes compared to their unimpaired peers. Importantly, for children with later problems, diminished MMN effects could already be observed at five months. These results suggest that deficient auditory processing associated with later writing problems arises during a time when infants typically develop language-specific phoneme representations. Thus, the current study is in line with the phonological deficit hypothesis, proposing that impaired auditory processing serves as one of the main causes of reading and writing problems, and is promising towards the utilization of the MMN as an early predictor for written language abilities.
Mechanisms behind emergent phonological skills: Effects of fluid intelligence and interrelationships between phonological subskills over time

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The study is based on theoretical notions and empirical results from two main areas of research: 1) research showing that phonological awareness (PA) provides a necessary foundation for early reading skills; and 2) research on the structure of cognitive abilities. We investigate the mechanisms through which cognitive abilities influence development of PA. PA comprises a set of subskills, which develop over time. Little is known about the structure of these subskills, but in this study we propose a model based on two dimensions of phonology. One is the linguistic complexity level (LCL): morphemes, syllables/rhyme, and phonemes. The other is the phonological complexity level (PCL): identification (ID), blending/segmentation (B/S), and manipulation (MAN). The phonological tasks were constructed through a complete crossing of these two dimensions. The tasks were administered to a sample of 222 children in a longitudinal design with three waves of testing at the age of four and five. At the first wave a broad range of cognitive tests measuring different aspects of fluid intelligence (Gf) was included. Based on Cattell’s Investment theory, we developed a set of specific hypotheses about the mechanisms through which Gf influences PA, and how phonological subskills influence one another over time. The phonological tasks were modeled with a multimethod-multitrait approach, yielding the three PCL factors ID, B/S and MAN with a phoneme factor. An autoregressive model was fitted to the three waves of data. Gf had a very high relationship to ID1, and the autoregressive effects from ID1 to ID2 to ID3 were very strong. There also were substantial effects from ID1 to B/S2 and MAN2, and from ID2 to B/S3 and MAN3. This implies that there was successive propagation of influence from Gf and ID on the other subskills. We thus conclude that this characterizes the development of early phonological skills.
Previous studies have shown that children suffering from developmental dyslexia have a deficit in categorical perception of speech sounds (Werker & Tees, 1987; Maassen et al., 2001; Serniclaes et al., 2001; Serniclaes et al., 2004). However, the potential theoretical value of the CP deficit only became apparent much more recently when it was shown that dyslexics not only have weaker discrimination between categories but also better discrimination within categories (Serniclaes et al. 2001). The CP deficit would thus reveal an allophonic mode of speech perception, characterized by the use of allophones rather than phonemes. This type of perception could get straightforward consequences during the establishment of grapheme - phoneme correspondences. Conversely, literacy process can drive changes from allophonic to categorical perception (Noordenbos et al., 2012). In this study we explored the evolution of the categorical and allophonic perception deficits in a Spanish sample (102 dyslexics and a control group of 109 from two schools levels, 7 & 9 yrs). In the first phase, children identified and discriminated ba/pa, de/te and di/ti syllables, along a voice onset time (VOT) continuum. All the continua showed the classical perception deficit, i.e. Spanish children with dyslexia discriminated among phonemically contrastive pairs less accurately than did chronological age controls. Children with dyslexia also showed higher sensitivity in the discrimination of allophonic contrasts, but only for one of the three continua under study (ba/pa). These results are consistent with other studies, suggesting that children with dyslexia perceive speech in a less categorical way and also that they exhibit enhanced discrimination of allophonic (subphonemic) contrasts. Second phase results are now being processed and they will be ready to be presented.
Frequency discrimination and dyslexia: A meta-analysis and moderator variable analysis

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The debate concerning the association of developmental dyslexia with deficits in basic auditory processing is ongoing. Research studies have yielded variable results which are difficult to interpret. The first objective of our study was to quantitatively assess the variability of effect sizes across the studies measuring one type of basic auditory processing, frequency discrimination (FD). Our second aim was to explore whether any of the cognitive or task design variables could moderate the variability of the FD effect sizes. To meet our first objective we performed a meta-analysis of n=29 experiments from 27 published articles which psychophysically assessed FD in dyslexic and control participants. Statistical significance of both the mean effect size (M=0.735; SEM=0.076) and the effect size variability demonstrated that although individual effect sizes were on average significant, they were inconsistent across studies. We also found considerable inconsistency among the cognitive and language measures used (real and non-word reading, phonemic deletion, non-verbal IQ, verbal working memory, and oral language), specifically 1) common use of non-standardised tests, and 2) lack of inclusion of key cognitive measures relevant to reading. Therefore, our finding that the effect size heterogeneity was not moderated by any of the participant variables needs to be treated with caution. Importantly, however, we found a relationship between the type of FD task and the variability of the FD effect sizes, such that larger effect sizes tend to co-occur with the FD tasks which may be more working memory-dependent, and smaller effect sizes with the tasks relying more on pattern recognition processes. The results of our study suggest that it would greatly benefit the literature if authors reported the key cognitive measures, including standardised tests, to facilitate across-study comparisons. Furthermore, the choice of FD task is important because performance on different FD tasks may depend on different underlying mechanisms.
Amplitude rise-time processing: A risk factor for dyslexia?

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In the longitudinal Dutch Dyslexia Programme (DDP), controls and children with a familial risk of dyslexia (FR) have been followed their entire pre- and primary school period. Over time the FR group has been divided into two groups; a group of familial risk non-dyslexic (FRnondys), and a group of familial risk dyslexic (FRdys) children, allowing us to discern factors that relate to reading and not merely relate to being at risk for dyslexia. The current study investigated whether more proficient basic auditory processing is related to reading fluency. We specifically address differences in amplitude rise-time (art) processing, as a diminished sensitivity to differences in art processing has been previously connected to reading fluency. Participants' sensitivity to amplitude rise time, intensity and frequency processing was measured with event-related potentials (ERPs). The ERP component of interest is the mismatch negativity (MMN), which reflects change detection. Our preliminary results indicate that controls, FRdys and FRnondys children do have an MMN to changes in art. No differences are found between groups. On intensity, only controls had an MMN. On frequency, we find a smaller MMN for FRdys and FRnondys compared to controls. Contrary to previous findings our preliminary results suggest that art processing is not related to reading fluency at all. Furthermore, our results imply that diminished sensitivity to changes in intensity and frequency should be regarded as risk factors for dyslexia that do not directly relate to reading fluency.
Brain responses reflecting early processing stage of speech signal is differently related to reading measures in typically reading children and those with dyslexia

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The role of speech processing problems as a risk factor for dyslexia still remain unclear. Here our purpose was to study whether brain responses reflecting early stages of speech processing (obligatory event-related potentials, ERPs) would be related to phonological processing, decoding and spelling skills in children with and without dyslexia. ERPs of 9 - 11-year-old Finnish children (50 typical and 58 dyslexic readers) were recorded to a repeated /i/-vowel presented in a cross-linguistic oddball-paradigm of a European NeuroDys study. Temporal principal component analysis (tPCA) was applied to identify the obligatory auditory responses. The ERPs at the time windows of P1 (70 ms) and N1 (110 ms) were differently associated with behavioral measures in dyslexic readers compared to typical readers. In typical readers, a larger P1 response at the right temporal areas was related to better performance in pseudoword phoneme deletion and pseudoword spelling tasks as well as faster pseudoword reading time. A larger response at the N1 time window was related to faster pseudoword decoding only. In dyslexic readers, however, a larger right hemispheric P1 was only related to pseudoword repetition. Instead, larger left hemispheric responses at the P1 and N1 time windows were related to better performance in the spelling task. In dyslexic readers, no association between obligatory ERPs and pseudoword decoding time was found. These results indicate that basic level speech processing is related to phonological processing, spelling accuracy, and decoding speed, but differently in dyslexic and typical readers. In typical readers, the associations of the responses at the right hemisphere to behavioural measures are in line with findings of right hemispheric dominance of vowel processing. Dyslexic readers show, in contrast, the opposite hemispheric pattern in the brain-behavior associations. This suggests differences in the organization of the neurocognitive processes related to reading and writing.
Auditory processing disorders have been widely implicated in developmental dyslexia, based on a large body of psychophysical work. However psychophysical methods can be challenging to use with populations who may have cognitive difficulties, especially in working memory and attention, because they require the participant to attend to, and respond to, large numbers of trials. This study used simulated psychophysical observers to explore the sensitivity of some commonly-used staircase techniques to individual differences in attention, and to differences in psychometric function slope. The simulated observers had a psychometric function defined by a Weibull curve, of a specified slope and threshold. They could respond to a 2-AFC task either exactly as determined by this psychometric function (ideal observers), or with a specified 'lapse rate', whereby they responded randomly on a specified percentage of trials, to mimic the effects of inattention. For any given threshold and psychometric function, the staircase procedures yielded a distribution of threshold-estimates, which enabled the procedure to be assessed for suitability based on its skew and kurtosis. The data suggest that staircases are more likely to produce high threshold-estimates for psychophysical tasks (or observers) with shallower psychometric functions. An example of a task with a relatively shallow psychometric function is frequency discrimination, whereas an example of one with a steep function is gap detection. Furthermore, an attentional lapse-rate of 10% (i.e., a random response on perhaps 3 or 4 trials within one staircase) can result in threshold-estimates which differ significantly from the same data in a matched group of 30 ideal observers. The size of this effect depends on the staircase procedure chosen. Taken together, these data suggest that choice of staircase procedure is very important when measuring auditory processing in populations of children with dyslexia or other developmental disabilities, and provide some guidelines for design of measures.
When adult dyslexics perform better: Evidence from comprehension and vocabulary tasks

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We predicted that adult dyslexics would perform worse than controls in spelling, phonological awareness, and various reading tasks. Similar performance to controls was expected on tasks that do not involve the activation of phonological representations. We recruited 17 dyslexics and 23 controls from New York City public and private colleges and from online forum posts. Our sample consisted of bilinguals/multilinguals and native English speakers in both groups. Socioeconomic status varied, but all participants had completed at least some higher education beyond high school. Taken together, our sample was diverse. Participants were individually tested on spelling, phonological awareness and reading tasks in one session lasting approximately 2-3 hours. In line with previous research, dyslexics performed worse than controls in single-word reading, spelling, nonword reading, and Spoonerisms (a phonological awareness task). Dyslexics also performed similarly to controls in semantic fluency (listing words belonging to the same category) and non-verbal ability (WAIS Block Design) as these tasks do not explicitly activate phonological representations. Dyslexics unexpectedly exhibited similar performance to controls on Woodcock Johnson (WJ) Reading Fluency, a silent-reading and comprehension task, and WJ Reading Vocabulary. Even more surprising, the dyslexics performed better than controls on WJ Passage Comprehension, and WAIS Vocabulary. These results of comparable or superior performance on reading comprehension and vocabulary tasks could be explained by the higher socioeconomic status and increased education of the dyslexic group. Furthermore, dyslexics may have acquired compensatory strategies over time through accommodations or self-education. Despite this compensation in comprehension and vocabulary tasks, dyslexic adults clearly still struggle with single-word reading and spelling and show a gap in achievement compared to controls.
Phonological task characteristics and the link with early reading: An analysis of stimulus and response-type

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Phonological accounts of reading implicate three aspects of phonological awareness tasks that drive the relationship with reading; a) the language-based nature of the stimuli (words or nonwords), b) the verbal nature of the response, and c) the complexity of the stimuli (words can be segmented into units of speech). Yet, it is uncertain which task characteristics are most important as they are typically confounded. By systematically varying response-type and stimulus complexity across speech and non-speech stimuli, the current study seeks to isolate the characteristics of phonological awareness tasks that drive the prediction of early reading. Four sets of tasks were created; tone stimuli (simple non-speech) requiring a non-verbal response, phonemes (simple speech) requiring a non-verbal response, phonemes requiring a verbal response, and nonwords (complex speech) requiring a verbal response. Tasks were administered to 570 2nd grade children along with standardized tests of reading and non-verbal IQ. Three structural equation models comparing matched sets of tasks were built. Each model consisted of two task factors with a direct link to a reading factor. The following factors predicted unique variance in reading: a) simple speech and non-speech stimuli, b) simple speech requiring a verbal response but not simple speech requiring a non-verbal-response, and c) complex and simple speech stimuli. Results suggest that the prediction of reading by phonological tasks is driven by the verbal nature of the response and not the complexity of the stimuli. Findings highlight the importance of phonological output processes to early reading.
Phonological awareness and working memory as predictors of dyslexia in Arabic-speaking preschoolers in Egypt

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Although the relationship between phonological awareness and working memory is well-documented in the English language, the relationship between the two variables in the Arabic language has had less attention (Zayed, Roehrig, Arrastia-Lloyd, & Gilgil, in press). This study examined the relationship between the predictors, phonological awareness and working memory, and the diagnosis of dyslexia in Arabic-speaking preschool children. The sample consisted of 40 preschoolers (randomly selected from a larger sample of 425) from seven preschools in Northern Egypt. All children were prescreened with a battery of tests including general intelligence (IQ), the Dyslexia Early Screening Test (DEST; Nicolson & Fawcett, 2002), the Wechsler Intelligence Scales for Children (WISC-III; Wechsler, 1997), a phonological awareness test in Arabic (Hanna Ezzat, 2005), as well as the Working Memory Test Battery for Children (WMTB-C; Pickering & Gathercole, 2001). A binomial logistic regression model was conducted to explore the relationship between phonological awareness and working memory for children at-risk for dyslexia and their counterparts. When working memory tasks (i.e. backward digit recall task, counting recall task, and listening recall task) were added to the regression model after phonological awareness tasks (i.e. rhyme detection task, syllable blending task, phoneme isolation task, and phoneme blending task), the phoneme blending task no longer contributed to the model. The phoneme isolation task (p < .001) was found to be the best predictor of risk status for dyslexia with scores for phonological awareness tasks and working memory tasks together explained about 94% of the variance in DEST scores. Implications of the findings in an international context will also be presented.
Lipread-induced phonetic recalibration in dyslexia

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Auditory phoneme categories are less well-defined in developmental dyslexic readers than in fluent readers. Here, we examined whether poor recalibration of phonetic boundaries might be associated with this deficit. 22 adult dyslexic readers were compared with 22 fluent readers on a phoneme identification task and a task that measured phonetic recalibration by lipread speech (Bertelson, Vroomen, & De Gelder, 2003). In line with previous reports, we found that dyslexics were less categorical in labeling of the speech sounds. The size of their phonetic recalibration effect, though, was comparable to that of normal readers. This result indicates that phonetic recalibration is unaffected in dyslexic readers, and that it is unlikely to lie at the foundation of their auditory phoneme categorization impairments. For normal readers however, it appeared that a well-calibrated system is related to auditory precision as the steepness of the auditory identification curve positively correlated with recalibration.
Is RAN phonological? It depends on the stimulus

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Purpose: A long-standing hypothesis is that RAN taps the integrity of a phonological access mechanism; however, this has been difficult to prove. Using Rime Neighborhood Density as a proxy of phonological representation, we tested the effects of phonology on RAN using both object and digit stimuli. For both stimulus types, we predicted faster RAN times for words from high density neighborhoods because, according to lexical restructuring theory, competition from many similar sounding competitors causes words from dense phonological neighborhoods to become more accurately represented in the mental lexicon (Goswami, 2001). Method: 29 university students with dyslexia and 29 normal controls completed two experimental object and digit RAN tasks contrasted for rime neighborhood density. To ensure that digit naming reflected lexical retrieval speed and was not influenced by visual similarities of Arabic numerals, participants repeated the experimental digit RAN in a third task in which numerals (i.e., 6, 9) were replaced with written number names (i.e., six, nine). Results: For object RAN, both groups named high density words faster (p< .0001), consistent with previous research. Also as expected, the dyslexia group was significantly slower than the control group on both high density and low density object RAN. For digit RAN, however, there were no group differences and, surprisingly, digits from high density neighborhoods were named slower than digits from low density neighborhoods (p< .0001). Digit results were duplicated on the number word RAN task. Conclusion: Results for digit (and number) RAN were inconsistent with lexical restructuring theory, suggesting either1) phonological codes for digit names are acquired, stored, restructured, or retrieved differently than phonological codes for object names or2) a non-phonological lexical variable (e.g. semantics, frequency) underlies access to digits. Overall, these findings suggest that phonology affects digit naming in a very different way than object naming, even in dyslexic individuals.
Visual and auditory search performance in dyslexic children

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It has been suggested that auditory and visual sequential processing deficits contribute to phonological disorders in developmental dyslexia. As an alternative explanation to a phonological deficit as the proximal cause for reading disorders, the visual attention span hypothesis (VA Span) suggests that difficulties in processing visual elements simultaneously would lead to dyslexia, regardless of the presence of a phonological disorder. In the present study, we assessed whether deficits in processing not only visual but also auditory elements displayed simultaneously is linked to dyslexia associated with a VA Span impairment. Sixteen children with developmental dyslexia and 16 age-matched skilled readers were assessed on visual and auditory search tasks. Participants were asked to detect a target presented simultaneously with 4, 10 or 16 distracters. Target detection performance was impaired in the dyslexic group compared to the control group in the visual modality only. Within the dyslexic group, both visual and auditory target detection measures strongly correlated with irregular word reading accuracy. They also were associated with VA Span but not phonological skills. The present data suggests that visual and possibly auditory simultaneous processing engaged in search tasks contribute to dyslexia via VA Span and/or orthographic knowledge deficits. Implications of the results for the "temporal sampling framework" of dyslexia in the auditory (Goswami, 2011) and the visual modalities are discussed, focusing on the links between the sequential and simultaneous dimensions of processing involved in reading, and the oscillatory frequency bands supporting cerebral processing.
Temporal processing skills of children at risk of specific language impairment or dyslexia

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Reading difficulties can be prevented through early intervention in many children. To that end, we investigated the role of perceptual processing as a core deficit in developmental language disorders as dyslexia or specific language impairment (SLI). Our goal in this study is to examine the temporal processing hypothesis in children at risk for dyslexia or SLI. We assume that a general temporal processing deficit is not restricted to the auditory modality and should be apparent in other sensory modalities. Thus, the present study extends the investigation to visual temporal processing. We compared the perceptive processing skills of 16 children at risk for developing dyslexia or SLI and 16 controls, all of them attending preschool level. Children were tested on two perceptual tasks, visual and auditory tasks of temporal order judgment (TOJ) where children indicated which signal appeared firstly. In addition, children performed a same-different discrimination task (S-D). The results showed that the performance in determining the order of stimuli was lower in children at risk for dyslexia or SLI in both TOJ tasks modalities. The present study suggests that the difficulty to process the temporal order in rapid succession of acoustic and visual items, could explain why some children fail to develop appropriate skills for learning to read and this difficulty could operate as an early predictor in SLI or dyslexia.
Visual and auditory temporal processing ability in linguistic and non-linguistic stimuli in children at risk for reading difficulties

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The purpose of this study is to assess if the temporal processing in visual and auditory modality is affected by the kind of stimuli (linguistic and non-linguistic) in children at risk for reading disabilities. In order to address the issue was necessary to control for the complexity of the stimuli across the temporal and acoustical dimension, and to administer tasks that adopt identical paradigms in both modalities. In this study participated 36 children (age, M= 67.86; SD= 3.53) at risk for reading disabilities (RD) and 36 (age, M= 67.38; SD= 3.91) without risk for reading disabilities (NRD) from kindergarten (i.e., just before the initiation of formal reading instruction) were tested on visual and auditory TOJ tasks taking into account linguistic and non-linguistic stimuli. The analysis of Group (RD x NRD) by auditory stimuli (linguistics - nonlinguistic) showed a significant interaction. Results indicated RD group? accuracy was lower than NRD group both linguistic and non-linguistic stimuli. Also, RD group? accuracy was lower in linguistic stimuli than non-linguistic stimuli while in NRD group? accuracy there was not difference. The analysis of Group (RD x NRD) by visual stimuli (linguistics - nonlinguistic) showed that the performance of NRD group was higher than RD group. The discussion highlights how investigating different stimuli can deepen our understanding of the role temporal processing plays in early reading difficulties.
Perceptive deficits in pre-school children at risk for dyslexia

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The aim of this study is to explore visual and auditory perception in children at risk for dyslexia. Recently, there has been renewed interest in perceptive problems of dyslexics. A polemic issue in research of dyslexics' perception is the nature of the deficit. It is questioned whether the perceptual deficit is specific to temporal processing. Another issue is the causal role of perceptive deficit in dyslexia. Most studies have been carried out in adults and children literates; consequently, the observed deficits may be the result rather than the cause of dyslexia. In order to answer these questions, 36 children at risk for dyslexia (RD) and 36 without risk for dyslexia (NRD) from kindergarten (i.e., just before the initiation of formal reading instruction) were tested on visual and auditory tasks of temporal order judgment (TOJ) and discrimination tasks (S/D). The results show an interaction Group (RD vs. NRD) x Modality (auditory vs. visual) x Task (TOJ vs. S/D). The children at risk for dyslexia, in visual and auditory modalities, perform poorer in tasks requiring temporal processing than discrimination tasks; while there were no differences between auditory temporal and discrimination tasks in the control group. Findings reveal that visual and auditory perceptive processing problems are present in children at risk for dyslexia and that the auditory perceptive deficit is specific to temporal processing. The present study suggests a causal link between temporal perceptual auditory deficits and dyslexia, as set out in the temporal processing theory.
An examination of working memory processing across modalities in developmental dyslexia

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The presentation includes 4 experiments aiming to explore working memory processing in developmental dyslexia, across modalities. The current set of studies utilise the N-back task. The first two studies adopted visual presentation, and letters (experiment 1) or objects (experiment 2) were presented with a non-target: target ratio of 2:1. The first experiment demonstrated a main effect of group upon WM processing, whereby dyslexic participants had significantly fewer hits at each level of N. However, their correct reject rate was comparable to controls. This was reflected in signal detection theory, whereby dyslexic participants adopted a significantly higher criterion than controls. Dyslexic participants used strategic responses in order to maximise overall accuracy during the task. In experiment 2, which did not involve phonological processing, these between group effects were not present. In the second set of experiments, auditory working memory was assessed using the N back task, for letters (experiment 3), and words (experiment 4), which were manipulated by Age of Acquisition (AoA). Critically, in experiments 3 and 4, the non-target: target ratio was 1:1. Experiment 1 revealed a main effect of load upon performance, alongside a main effect of group, and an interaction between N*group. Thus, as the demand upon WM increase, group effects emerged. Unlike experiments 1 and 2, this group differences was driven by non-target trials, with dyslexic individuals displaying increased false alarms. Experiment 4 demonstrated an effect of WM load upon accuracy, however there was no interaction between N * Group. Furthermore we replicate experiment 3, with an increased false alarm rate amongst dyslexics. AoA played a crucial role in reaction times (RTs), with shorter RTs for earlier learned words. With a 1:1 target ratio, it was not possible for dyslexic participants to rely strategic responses. Results will be presented in terms of accuracy, signal-detection and EEG analysis.
ERP-based assessment of letter-speech sound integration in dyslexic and normally reading children

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The acquisition of letter-speech sound associations is one of the basic requirements for learning to read and deficient letter-speech sound associations may form the basis for reading difficulties in developmental dyslexia. Previous electrophysiological studies employing a cross-modal oddball paradigm revealed a late automation of these associations in normal readers and little automation in dyslexic readers. In the present study we employed the same cross-modal paradigm to extend these findings to dyslexic (n=22; 8.87±0.43 years) and normally reading (n=20; age: 8.68±0.37 years) children with 2.5 years of reading instruction. EEG data were recorded while the children listened to Dutch vowels /a/ (standard, 83%) and /o/ (deviant, 17%) in one auditory and two cross-modal conditions. In the cross-modal conditions the letter 'a' was presented either simultaneously with the vowels (AV0) or 200 ms before vowel onset (AV200). In line with previous findings, our results show comparable auditory mismatch negativity (MMN) responses to vowels in dyslexic and normal readers. In normal readers, the cross-modal conditions lead to enhanced MMN and late mismatch (~700 ms) responses for both the AV0 and AV200 conditions. Dyslexic children showed less cross-modal enhancement with an MMN enhancement only for the AV200 condition and a small late enhancement in the AV0 condition. These preliminary results indicate that after 2.5 years of reading instruction, normal readers show automatic integration of letters and speech sounds however at a different temporal window of integration in comparison with experienced readers. Furthermore, our results further confirm deficient letter-speech sound integration in dyslexic children.
Evidence in favor of the sluggish attentional shifting hypothesis of dyslexia: A magnetoencephalography study in dyslexic children

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Phonological difficulties in developmental dyslexia are believed to arise from a more general auditory processing deficit, hindering phonological analysis of speech. A magnetoencephalography (MEG) study shows atypical neural oscillations in dyslexic participants to slow auditory stimulus modulations (~2 Hz), thought to contribute to impaired amplitude rise time analysis in speech (Hämäläinen et al., 2012). Another reports abnormal neural oscillatory activity restricted to high frequency oscillatory response (~30 Hz), interpreted as a ?phonemic oversampling? in dyslexic participants (Lehongre et al., 2011). In the present MEG study, we compared phase locking responses to amplitude modulated white noise at different modulation rates in children with (n = 8; 12.4 y.o ± 3) and without (n = 7; 12.8 y.o ± 2.5) dyslexia. Each frequency rate (2, 4, 7, 10, 15, 30, 60 Hz) was randomly presented in 10s-blocks 25 times. Participants were watching a silent movie whilst listening to the modulated noise. For each rate, segments including 2 oscillatory cycles were analysed. Inter-trial phase locking between segments was estimated using gradiometer data for each participant. Results showed significant effects in the right hemisphere at 4 Hz [p<0.05, Figure 1, right panel] and in the left hemisphere at 15 Hz [p<0.05, Figure 1, left panel]. These results show abnormal neural synchronisation i) in slow auditory frequency ranges (i.e., 4 Hz), more prominent in the auditory cortex of the right hemisphere in accordance with the ?temporal sampling? hypothesis of Goswami (2011) and ii) at 15Hz in the left hemisphere. This last result is discussed in light of the sluggish attentional shifting theory of dyslexia (Hari and Renvall, 2001).
Neurodevelopmental correlates of the rapid-automatized-naming in typical and atypical developing readers

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The relation between rapid naming and reading success has been extensively documented. Performance on the rapid-automatized-naming (RAN) task predicts reading skills and discriminates between individuals with dyslexia and normal readers. The RAN task and complex reading tasks seem to rely on similar neurocognitive processes, such as binding spoken and visual signals. In addition, similar neural structures are being recruited by RAN and reading tasks, including the inferior frontal gyrus, temporoparietal cortex, and the ventral visual stream. Nevertheless, to date, no studies have examined age-related changes in the neural correlates supporting rapid naming in typically developing readers and individuals with dyslexia. Moreover, limited evidence exists on the neural differences between readers with dyslexia and typical readers of languages with shallow orthographies, like Spanish. The present study is aimed at investigating the neurodevelopmental correlates of alphanumeric and non-alphanumeric components of the RAN task in typical and atypical readers. We are currently collecting functional MRI data from a total of 54 children and young adults (to date, N = 38) while they are overtly naming blocks of numbers, letters, objects, colors and control conditions tailored to each participant’s naming speed. Groups of readers are matched on age, gender and IQ. Consistently with prior findings, our data show associations between RAN performance and reading abilities. Importantly, preliminary fMRI data indicate that: 1) the RAN recruits a network of neural structures also involved in more complex reading tasks; 2) compared to typical readers, atypical readers engage more extensive right-lateralized regions, possibly suggesting compensatory mechanisms or effortful processing; and, 3) typically developing readers show a more sustained activity in regions within the reading network relative to readers with dyslexia, indicating that poor readers exhibit a higher difficulty sustaining processes needed for retrieval. We expect that we will also observe differences in coupling strength among these regions as a function of age and reading groups.
Deficient letter processing in developmental dyslexia: What are the processes involved?

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The link between anomalous letter processing and developmental dyslexia has hitherto been unclear. The present study was aimed to (i) clarify the direction of causality between developmental dyslexia and deficient letter processing; and (ii) examine what are the processes involved in this putative deficit. Three groups of children - phonological dyslexics and two controls, one matched for chronological-age, the other for reading-level - performed a sequential same-different matching task, in which the inner target (either a letter or a pseudo-letter) was surrounded by a congruent (with the same global form) or incongruent geometric shape. For pseudo-letters, all groups showed congruence effects (CE: better performance when the target was surrounded by a congruent than incongruent shape). In contrast, for letters, only dyslexics exhibited a CE, thus differing not only from chronological-age but also from reading-level controls. The observation of CEs for both letters and pseudo-letters by dyslexic readers could thus depend on the adoption of the same processing mode for both materials or, alternatively, on the adoption of a deficient letter-specific procedure. We explored these two possibilities, specifically examining in dyslexics the association between the letter and the pseudo-letter CEs and the explanatory power of two latent variables (extracted from a Principal Component Analysis) on each of them, after partialling out the variance explained by age and nonverbal intelligence. The letter CE displayed by dyslexics was strongly related to their phonological recoding abilities even after partialling out working memory, whereas the reverse held true for the pseudo-letter CE. The present results suggest that deficient letter processing by dyslexics can be traced back to their phonological recoding deficit.
The case of the sequence: Differentiating serial order from item recognition in Italian speaking children with dyslexia

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This study joins the line of research investigating the processing of serial order information in short-term memory in dyslexic individuals. Recently, some models of short-term memory make a distinction between order and item processing, in which order information represents a domain-general function of short-term memory, whereas item information is a short-term activation of long-term memory. In a sample of dyslexic and normal reading school children, we investigated whether serial order processing problems in dyslexia are linked to a selective impairment of short-term memory for serial order, and whether this impairment affects processing in both the verbal and the nonverbal domains. Twelve dyslexic children and matched control groups for chronological age (CA) and for reading age (RA) participated in a controlled 2 (task) x 2 (material) experiment. It consisted of a double probe short-term recognition task for order (correct order of the two probes?) and item information (had both items been present?) with verbal (object drawings) and nonverbal material (nonsense symbols) respectively. Within the item conditions, half of the true probes were presented in consecutive order and the other half in opposite order. Findings indicate that all participant groups performed at the same level in each of the item tasks. But the ability to correctly identify the serial order was found to be weakest in the dyslexic group and significantly highest in CA controls. The RA control group obtained an intermediate position. Moreover, serial order information from true probes in item tasks facilitated processing in control groups, whereas there was no influence of serial order on item task performance in the dyslexic group. The results support the assumption that serial order processing in short-term memory is selectively impaired in dyslexia, and that this fact is only partly covered by co-development of reading level and serial order processing.
Attentional processing deficits in developmental dyslexia

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The cognitive causes of developmental dyslexia are yet a matter of debate. Recent studies have challenged the phonological theory of dyslexia as the only cause of the reading difficulties; suggesting deficits in balance, motor control, and low level sensory and attentional processing. These deficits are supported by anatomical evidence that shows that dyslexic brain has anomalies in the Cerebellum, Corpus Callosum, Thalamus, and Perysilvean cortex. This study focuses on the visuoatentional deficits that occur in dyslexia. These consist of difficulties integrating and correctly identifying fast sequences of stimuli. Two different hypotheses have arisen in order to explain this deficit. The Visual Attention Span Deficit hypothesis suggests that dyslexics have deficits in the amount of distinct visual elements that can be processed in parallel. On the other hand, the Sluggish Attentional Shifting hypothesis suggests that dyslexics have difficulties in moving the attentional focus between the different elements of a series. The two deficits may interact and co-occur among deficits in different domains. We asked a group of dyslexics university students to compare two strings of eight unknown characters (Arabic) and look for differences. The strings differed in whether there was a difference or not, and in the position where the difference was. Dyslexics were significantly slower than controls, while maintaining the same performance level than controls. The differences in reaction times between dyslexics and controls increased as the differences between the stimuli occurred later in the character strings. Both controls and dyslexics show a crowding effect near the middle and the end of the string, but these effects seems to hamper dyslexic participants performance significatively more than controls. These results cannot be explained by a phonological or lexical processing deficit, since this characters are completely unknown to the participants and thus no phonological information is activated while performing the task.
Time estimation deficit in developmental dyslexia

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Time estimation is the ability to judge the duration or apprehend the passage of time by the order of occurrence of experience or by physiological rhythm (Fraisse, 1984). It plays quite significant role in language disorder specially developmental dyslexia. It is characterized by deficits in phonological processing abilities. However, it is unclear what the underlying factors for poor phonological abilities or speech sound representations are. The deficit in phonological processes has been for the processing of paired tones or temporal sequences different when relatively short time intervals are used in individuals with dyslexia compared to typical readers. This paper presents the results of a study that was undertaken to determine the effects of method of time judgment, and paradigm on dyslexic and atypical readers. An experiment was conducted using 115 children (age: M=12.23 years, SD = 1.30), 51 dyslexics and 64 typical readers. The data obtained through the method of verbal estimation and reproduction. Analysis of variance was used to analyse the data. Time judgments data were analyzed using directional error. For directional error, all the main effects and few interactions were significant. Children with dyslexia showed more error in time estimation (M=0.59, SD=0.52) as compared to typical readers (M= 0.83, SD=0.74). Estimation of duration under the prospective paradigm was more accurate than under the retrospective paradigm for both dyslexics and typical readers. However, dyslexics were more error prone as compared to typical readers. Time judgment was accurate under verbal time estimation as compared to reproduction method. Keywords: Duration, Language disorder, Phonological deficit, Typical reader.
The g factor of reading development

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Several models of reading development postulate that phonological skills, especially phonological awareness play an influential role in reading acquisition. This view is also supported by factor-analytic studies, in which the assumed phonological factor strongly (and often reciprocally) predicts the level of the reading factor. However, these models make the strong assumption that factors (latent cognitive skills) and specific subgroup of tasks have a close and exclusive relationship. This means that all covariances between the observed performance on distinct tasks (e.g. phoneme deletion, pseudoword reading, rapid naming of letters) can be explained by the covariance of distinct factors (e.g. phoneme awareness, phonological recoding, RAN). Based on the reanalysis of a large, international database (N > 2000) of the 3DM reading battery, we suggest an alternative view: the common variance between all reading related tasks is directly attributable to a general (g) factor, and specific, independent factors account for additional covariances between specific subgroups of observed measures. (The model resembles the direct hierarchical model of general intelligence.) We argue that the g factor of reading reflects low-level cognitive abilities of strong biological origin, which determine how fast and effectively the subsystem of fast, automatic, phoneme-level access develops in the phonological system, enabling the mapping or recoding of phonological and orthographic information at an elementary level. However, g is not omnipotent: specific factors explain a remarkable portion of shared variance between reading fluency measures, between accuracy measures of various tasks, between speed measures of several tasks, etc. We reviewed various behavioural genetic studies, re-analysed published datasets of large-scale reading studies, and conducted an additional large-scale experiment; all of these provided strong, independent support for our model. The model is universal (in the sense that it is not language-specific) and general (in the sense that it relates to both typical and atypical reading development).
Letter-speech sound mapping within an artificial orthography: A comparison between dyslexic and non-dyslexic readers

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In alphabetic languages the acquisition of letter-speech sound associations is a critical step in becoming a proficient reader. A disrupted automation of these associations could be an important underlying factor in severe reading problems, such as developmental dyslexia. In the present study dyslexic (N=46) and non-dyslexic (N=45) readers engaged in a short training (20 minutes) aimed at learning eight basic letter-speech sound correspondences within an artificial orthography. After the training we assessed both letter knowledge and word reading ability in this unfamiliar script. In addition, we applied regression analyses to test how disrupted letter-speech sound mapping relates to other phonology-related deficiencies, such as poor phonological awareness and poor rapid naming skills, when it comes to predicting reading and spelling skills. The findings indicated that after the training the non-dyslexic readers outperformed the dyslexic readers on both letter-speech sound matching (accuracy and speed) and word reading ability in the artificial script, providing empirical support for the view that a letter-speech sound binding deficit is a key factor in dyslexia. Furthermore, hierarchical regression analyses indicated that differences in reading and spelling ability were significantly associated with all measures related to the artificial orthography. Moreover, these three measures contributed unique variance in predicting reading and spelling ability, even when variance due to phonological awareness and rapid automatized naming had been accounted for. The implications of this study will be discussed in the context of applying learning-oriented tools for the assessment of dyslexia.
Dyslexia and its accompanying cognitive impairments have recently been attributed to a problem in the long-term learning of serial-order information. In immediate serial recall tasks dyslexic adults did not benefit from the repetition of one particular sequence, whereas normal readers did. The absence of such a Hebb repetition effect suggests a domain general learning problem in dyslexia. In the present study we examined the Hebb repetition effect in dyslexic and normal reading children. We compared a group of 27 fourth grade poor readers with a group of 27 normal reading children. The groups were matched on age, non-verbal IQ, vocabulary and gender. Both a verbal-verbal and a visual-spatial serial recall task were administered. In the verbal-verbal task the children listened to sequences of six digits and responded verbally by repeating the sequence. In the visual-spatial task the children watched a frog appearing in six position on a computer screen and were instructed to respond by clicking on the positions in the correct serial order. In each task, every other sequence was repeated (Hebb trials) and performance on the Hebb trials was compared to the performance on the other varying sequences (filler trials). In both groups and on both tasks, we found an improved recall of the Hebb trials compared to the filler trials. Furthermore, the average readers were better in serial recall of both trial types compared to the poor readers, also on both tasks. Taken together, poor reading children performed worse on the immediate serial recall tasks compared to their normal reading peers but they did not show a smaller Hebb repetition effect. Our results do not support that there is a problem in the transfer of serial order information to long term memory in dyslexic children.
Reexamining Paired Associate Learning (PAL) deficits in dyslexia

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Children with dyslexia exhibit specific deficits in visual-verbal paired associate learning (PAL) that cannot be explained by general associative learning deficits (e.g. Vellutino, Steger, Harding, & Phillips, 1975). These deficits are observed across languages, despite variations in orthographic, phonological, and morphological complexity (Li, Shu, McBride-Chang, Liu, & Xue, 2009; Mayringer & Wimmer, 2000; Messbauer & de Jong, 2003). However, whether these deficits reflect difficulties in crossmodal mapping or verbal learning is less clear. We present a series of experiments investigating this question. Experiment 1 investigated the specificity of PAL deficits by dissociating crossmodal and verbal demands. Children with dyslexia (N = 18) and age-matched controls (N = 18) were compared across the following mapping conditions: visual-verbal, verbal-verbal, visual-visual, and verbal-visual PAL. One mapping condition was tested per week for four weeks. Participants completed a computerized PAL task comprised of two presentation blocks and five test blocks with feedback. Accuracy across trials was analyzed in a logistic linear mixed effects model. Experiment 2 investigated whether visual-verbal PAL deficits reflect difficulties in the verbal learning or associative learning component of the task. Children with dyslexia (N = 14) and age-matched controls (N = 14) were tested across two days. On day one, children were pre-exposed to the phonological forms in a nonword learning task. On day two, children learned to pair the same nonwords with visual forms. Performance was analyzed in a linear mixed effects model. Children with dyslexia exhibited selective deficits in visual-verbal and verbal-verbal PAL, but performed as well as their peers in verbal-visual and visual-visual PAL. Results of Experiment 2 revealed an item-specific relationship between nonword learning and later associative learning success. Additionally, associative learning deficits were fully accounted for by verbal learning deficits. There was no evidence for an additive relationship between the two.
Cognitive training effects in children with reading difficulties: A pilot study

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Background/Aim: Attention deficit hyperactivity disorder (ADHD) is a frequent disorder like dyslexia in which co-occur reading disabilities. This study investigates the efficacy of cognitive training in reducing reading difficulties in children with reading disabilities, characterizing them in terms of neuropsychological patterns.

Method: 42 children, with ages between 5 and 11 years, divided into three groups: a control group of 8 children, a group of 15 children with dyslexia and another of 19 children with ADHD. All participants were submitted to a neuropsychological evaluation to assess cognitive functions such as attention, executive function, memory, working memory and visuo-perceptive functioning. Reading performance was measured by the number of errors done while reading, number of correct words read within a minute and reading velocity. These measures were then correlated with cognitive measures. After the first psychological evaluation all children were submitted to cognitive training during 6 months to improve higher brain functions. At the end of this phase they were reevaluated to determine the efficacy of the cognitive training on reading performance.

Results: Statistically significant differences were observed between groups for episodic memory (p<0.05), verbal abstract reasoning (p<0.001), semantic memory (p<0.05), verbal comprehension (p<0.05), sustained attention (p<0.05), visual memory (p<0.05), executive functioning (p<0.05), visuo-perceptual functioning (p<0.05), number of correct words read in a minute (p<0.05) and reading velocity (p<0.05). Significant differences were also demonstrated before and after cognitive training for verbal abstract thinking (p < 0.05), visuo-perceptual functioning (p < 0.05), delayed visual memory (p < 0.05), number of correct words read in a minute (p < 0.05) and reading velocity (p < 0.05). Reading performance correlates significantly with improvements in executive function, verbal memory, episodic memory, working memory and visuo-perception function.

Conclusion: Cognitive function enhancement improves reading performance in children with reading disabilities.

Key words: Dyslexia; ADHD; Cognitive training; Reading disabilities.
Effects of transcranial direct current stimulation (tDCS) on reading processes: A pilot study

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BACKGROUND: tDCS is a noninvasive brain stimulation technique which is gaining interest in clinical field, especially for rehabilitation purposes. The aim of this pilot study was to test the effects of tDCS over the left posterior temporal cortex, on reading processes in good readers and in dyslexics performing a words and nonwords reading task. We hypothesized that anodic stimulation facilitates the reading performance. METHOD: One group of 30 good readers and one group of 15 dyslexics were tested in 3 sessions (sham, anodal, cathodal). tDCS was applied over posterior temporal lobe, with a current of 1.5 mA, lasting for 20 minutes. Subjects task was to read aloud lists of words or nonwords, before and after stimulation. During the stimulation participants read a book. We recorded reading times and accuracy of every single lists (words and nonwords) before and after the stimulation. RESULTS: Regarding reading times, we found a faster performance after tDCS. We couldn’t discriminate between different types of stimulation, maybe because of task simplicity. Similarly we found an improvement in reading accuracy for nonwords after tDCS and a better performance after anodal stimulation. Concerning the dyslexic group, we found a significant improvement in reading times for nonwords after anodal stimulation. Further experiments are necessary to prove the benefits of tDCS for reading processes and more generally for rehabilitation purposes.
E-readers facilitate reading in dyslexia: An eye-tracking study

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Digital devices have spurred an extraordinary evolution in the social conventions for reading. People with dyslexia remark that reading on handheld e-readers is easier than traditional methods, and previous studies (Schneps, O'Keeffe, Heffner-Wong, & Sonnert, 2010) suggested that short linewidths used in these devices may facilitate reading in dyslexia by reducing demands on visual attention, impaired in dyslexia (Franceschini, Gori, Ruffino, Pedrolli, & Facoetti, 2011). Here, we describe new research that shows that when handheld mobile devices capable of displaying text (e.g., smartphones) are configured to display only a few words in a line, reading rates are increased 27%, and regressive gaze shifts are cut in half. In addition, we find that increasing inter-letter spacing to reduce crowding (Zorzi et al., 2012) helped those most impaired. We interpret these observations in terms of a model for reading in dyslexia. Here, we suggest that attention processes that ordinarily inhibit perception of text previously read are impaired in dyslexia (e.g., inverse pseudo-neglect; Michel, Bidot, Bonnetblanc, & Quercia, 2011)). We suggest regressive saccades arise when gaze shifts abruptly alter the percept of crowding in the parafoveal span previously read, ordinarily inhibited by attention in strong readers. Short lines mitigate this effect by reducing the occurrence of text to the left of fixation.
Changes in voicing categorical perception in SLI children: What can auditory training teach us?

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Might auditory training improve categorical perception in French SLI children? Using a perceptual fading task center across the French phonological VOT boundary during four weeks, one group of SLI children was training to discriminate difference across the /d??/ and /t??/ French phonological boundary. They were compared to another group of SLI children who did not participate to the training. Results showed that children from the training group learned to better discriminate phonological differences and to inhibit allophonic (i.e. subphonemic) differences. Also, training to discriminate cross-boundary differences improved phonological awareness. These promising results showed that, as far as voicing is concerned, auditory training can modify auditory-perceptual performances in children with SLI. With some difficulties at the beginning of training, children can progressively improve their performance on a task pointing specifically their difficulties with voicing. Their categorical perception improved significantly after training and this improvement was also generalized to phonological awareness. Further studies should allow evaluating the consequences of cross-boundary training on reading performances.
Evaluating the evidence base for Safari dos Sons in the training of phonological awareness

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The SLD field in Portugal has shown a slow evolution. However, parents and teachers recognize this group of children, the government doesn’t recognize them. Therefore, many families look for private centers, like CADIn, for identification, assessment, and intervention. CADIn is a non-profit institution, privately funded, with the goal of providing the best clinical care, teaching and research in the field of developmental disabilities. Cadin team also is interesting in developing intervention materials adequate to the development of basic skills that are essential for the reading and writing success, like phonological assessment. In 2012 our second game started to be commercialized, it is named Safari dos sons (Sounds Safari), we consider it a material of high quality to phonological awareness training, and a essential area to be part of an intervention plan for children with reading and writing specific learning disabilities, as Lyon, Shaywitz and Shaywitz, (2003) refer the typical disabilities in students with dyslexia usually reflect deficits in the phonological component of language. In this game are included exercises with rimming, segmentation, blending and manipulation of syllables and phonemes in an increasing degree of difficulty, and that can shape the needs of each student. All these exercises are made in an enjoyable and fun way, with reinforcements when the child achieves success. In antecedent studies, we’ve made, the results have shown that our instruction focus on academic problems (73.5% - 47% on reading, 25.9% on writing, and 0.6% on mathematics), and phonological awareness problems (89.6%), the improvement is seen in all areas above 75% in phonological awareness, above 50% in other fields. We intent to present the preliminary results of a single-subject design study investigating the effects of using safari dos sons on the training of phonological awareness.
Early identification of reading disabilities is critical for effective intervention and treatment of children with dyslexia. This investigation examined the usefulness of screening at the beginning of kindergarten (about 5 years of age) and response to instruction during the kindergarten school year for the identification of children at risk for reading disabilities (RD). Participants were 313 kindergarten children selected over two consecutive years. These children were administered a battery of screening measures during the fifth and sixth weeks of school. Progress monitoring assessments were administered throughout the kindergarten year to measure children’s response to instruction in letter knowledge and phonological awareness. Reading outcomes were assessed at the end of 1st grade using subtests from the Woodcock Reading Mastery Tests-Revised and the Test of Word Reading Efficiency-2. Children with RD were defined as those who were reading below the 16th percentile (based on local norms) on a composite measure of the reading assessments. Stepwise and nested logistic regression analyses were carried out. Results showed that a small number of screening measures, including those assessing letter identification, phonological awareness, and rapid naming accurately predicted reading outcomes (AUC = .92). To examine if response to instruction improved prediction of reading outcomes, growth curve analyses were performed on progress monitoring data. When growth in letter knowledge (i.e., slope) was added to previous screening models, the prediction of reading outcomes were significantly improved (AUC = .95). Growth in phonological awareness was not a significant additive predictor. These results indicated that a combination of screening and response to instruction accurately predicted children at risk for reading disabilities. Such screening information could be useful for the implementation of an intervention program directed at improving the reading outcomes of children with dyslexia.
The present study aimed at identifying some preschool predictors of reading difficulties in Chinese and developing a preschool screening tool for use by teachers to identify Chinese children at risk for reading difficulties. 343 Chinese children were recruited from 19 representative kindergartens in Hong Kong and they were followed from Kindergarten second year (K2) to Grade 1. They were tested on Chinese word reading, English letter naming, rapid digit naming, and two orthographic skills at K2 and K3. In order to examine the predictive power of these preschool skills for later dyslexia status, 98 children were administered a standardized Chinese dyslexia test at Grade 1. To ensure that more children with reading difficulties could be screened out in the sample, the first graders with low preschool word reading score were over-sampled for dyslexia assessment. Based on the results of the dyslexia test, 52 of the first graders were classified as normal readers and 46 were dyslexic or poor readers. It was found that the two groups differed significantly in all the preschool measures. Results of logistic regression showed that age, IQ, and Chinese word reading at K2 were significant predictors of the dyslexia/poor reading status in Grade 1 with an overall correct classification rate of 87%, while age, IQ, Chinese word reading, rapid digit naming, and lexical decision were significant K3 predictors with an overall correct classification rate of 89%. These findings suggest that Chinese dyslexic children already have difficulty in learning to learn at preschool stage and they show early difficulties in rapid naming and orthographic skills. A screening test was developed for quick identification of at-risk Chinese preschool children based on these findings.
Differences in profiles of disabled readers: Is everyone dyslexic?

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Reading as a highly advanced cognitive-linguistic skill can be viewed as two-component model (Gough & Tanmer, 1986). Oral-language-related component includes the lexicon and knowledge of morphosyntax, both of which facilitate comprehension, while linguistic-code-related component is associated with word recognition and depends on initial phonological representations, which form the basis of future decoding and encoding. Aside from vocabulary, one of the crucial skills in reading acquisition is phonological awareness (PA) i.e. abstract skill that allows manipulation of individual phonemes within the word structure. PA developmentaly depends on aspects of verbal working memory (VWM), i.e. phonological memory (PM) and working memory (WM) capacity. Success in performing PA tasks depends on either PM or WM capacity. Rapid automotized naming (RAN) has also been associated with success in reading (Wolf, 1997). Traditionally, children with dyslexia have shown deficits along the phonological processing continuum (Frith, 1995), resulting in poor graphem-phoneme mapping. Some individuals with dyslexia may exhibit deficits along the oral language continuum as well, such as delayed language acquisition and some deficits in both aspects of VWM. However, other clinical populations with speech and language disorders, such as Childhood Apraxia of Speech (CAS) may also exhibit poor reading outcomes. This particular population may have sever deficits in all aspects of reading pre-requisites. This paper examines underlying psycholinguistic and reading profiles of a child with reading deficits associate with phonological processing deficits and classified as phonological dyslexic and a child with CAS and reading deficits. The differences in underlying pre-requisite skills and subsequent reading outcomes highlight the need for better understanding of the nature of deficits in reading for better classification of children with reading disabilities that will lead to better instructional practices.
New insights on developmental dyslexia subtypes: Heterogeneity of mixed reading profiles

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We examined whether classifications based on reading performance are relevant to identify cognitively homogeneous subgroups of dyslexic children. Each of the 71 dyslexic participants was selected to have a mixed reading profile, i.e. poor irregular word and pseudo-word reading performance (accuracy and speed). Despite their homogeneous reading profile, the participants were found to split into four distinct cognitive subgroups, characterized by a single phonological disorder, a single visual attention (VA) span disorder, a double deficit or none of these disorders. The two subgroups characterized by single and contrasted cognitive disorders were found to exhibit very similar reading performance but more contrasted spelling performance (quantitative analysis). A qualitative analysis showed that different cognitive disorders resulted in different error types in reading as in spelling. The overall findings disqualify subtyping based on reading profiles on words vs. pseudo-word as a classification method to identify cognitively homogeneous subgroups of dyslexic children. The present findings have important implications from a clinical perspective. Although reading profiles provide valuable information on the development of the reading system and adequate assessment of the two reading procedures functioning, it is clear from our results that they provide no reliable information on the cognitive disorders involved in the reading problem. Thus, the clinician must do additional investigations more directly targeted towards the identification of associated cognitive disorders, in order to identify which remediation program is more appropriate to improve the child’s reading performance. Specific assessment of phonological skills is required, all the more that our results indicate that poor pseudo-word reading is not a sufficient clue to conclude that an underlying phonological disorder is at play. Investigation of VA span abilities is further required as more and more evidence suggests a specific contribution of this component to normal and atypical reading and spelling.
The DIS-ESP battery automated report: A model for the differential diagnosis of developmental dyslexia

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The DIS-ESP battery (Carrillo, Alegría y Luque, in press) presents a differential model for the diagnosis of developmental dyslexia based on the phonological theory (Snowling, 2000). This battery proposes a three stages process: first, a detection phase, second, the assessment of word reading mechanisms and, finally, the assessment of phonology. Once the child’s scores are introduced in the system, a diagnostic report is automatically obtained. This report includes a main synthesis section, detailed data of different assessments, and a diagnostic guidance. In order to estimate the severity of the detected deficits a comparison with chronological age and reading level control groups is provided. The protocol also allows to use the results to get subtype studies (Castles & Colheart, 1993; Lovett, 1984; Bowers & Wolf, 1994); and, to make further analysis like word length and lexicality effects; phonological awareness levels. The main objective is to facilitate the work of practitioners providing a quick and reliable prognosis tool, and to get cues for the differential diagnosis between reading delay and developmental dyslexia.
The current study examined the interplay of lexical and sublexical processing across reading development in 35 English native speakers in Grades 1 to 4. We designed several tasks to determine the degree to which the participants relied on different cognitive reading strategies. Nonword and irregular word reading accuracy were used to assess overall lexical and sublexical processing. The Length and Lexicality effects measured the extent to which the children relied on lexical versus sublexical processing in single-word reading, and whether this depended on their overall reading ability. In addition, we created a series of nonwords to assess the degree to which children relied on the context of each letter-sound correspondence. These nonwords all contained the grapheme 'a', which in different contexts can be pronounced as in 'cat', 'car', 'cake', 'call', or 'what'. We found that, with increasing reading ability, children provided more nonword responses that were appropriate to the context, while younger and less skilled readers gave a larger proportions of implausible 'a'-responses, such as pronouncing the nonword 'kazz' to rhyme with 'maze'. This suggests that there are changes to the nature of sublexical processing as children learn to rely more heavily on the context of each letter-to-sound correspondence to disambiguate the inconsistent grapheme-phoneme correspondences of the English orthography. Exploring the development of the Length and Lexicality effects, we found the Length effect decreases, while the Lexicality effect increases in more skilled compared to beginning readers. This is in line with previous research, suggesting that children increasingly rely on lexical compared to sublexical processing as they become more fluent readers.
Sensitivity to word inversion and word length provides a window into reading procedures in typical and dyslexic readers

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Proficient readers are slow, though surprisingly accurate, at reading upside-down text (word inversion effect, WIE). When a word is inverted, reading speed is influenced by string length (word length effect, WLE). In contrast, a frequently encountered word displayed in a standard orientation is recognized quickly irrespective of length. The purpose of this study was to test hypotheses related to reading procedures, using the emergence of a WLE as an indicator for a shift from a holistic-automatic procedure to an analytic-controlled procedure. To induce a WLE we rotated words by 180°, and examined the impact of inversion on the performance of two populations with different reading skills: adults with a history of developmental dyslexia and age-matched typical readers. Participants performed a naming and a semantic decision task in their native Hebrew language. In both tasks, we used high-frequency words and manipulated display orientation (standard, inverted) and word length (3-, 4-, 5-letters). As predicted, typical readers were not sensitive to word length when items were displayed in a standard orientation. Surprisingly, contrary to our prediction, dyslexics' pattern of performance was similar to that of typical readers for standard words. When inverted words were displayed, RTs in both groups increased considerably (the WIE) and a WLE emerged. Interestingly, in the inverted condition the dyslexic group was faster than typical readers at making a semantic decision for short words; whereas, they were slower than typical readers at naming long words. In order to distinguish between general-perceptual and linguistic explanations of the inversion effect, the participants also performed a classic mental rotation task. The results did not support a general-perceptual explanation of this effect. Assessing sensitivity to word inversion with respect to string length revealed interesting differences between dyslexic and typical readers. These differences provide new insights on the reading procedures used by each group.
Effects of word concreteness and active mental imagery on working memory performance in dyslexic children

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Dyslexic individuals exhibit poor performance on memory verbal span tasks which have been suggested to result either from impaired processing in the Phonological loop, from poor processing of the central executive system (Sela et al., 2012), a reduction in perceptual processing speed (Stenekken et al., 2011) or working memory storage capacity. Recent evidence indicates that the deficit also involves visual-object and visual-spatial information (Menghini et al., 2011). Hence, as has been shown for normal readers, a number of taskrelated factors modulate working-memory performance, including memory load, phonological similarity, and word-length. The aim of the present study was to explore the effects of 1/word concreteness and 2/ active imagery strategy on working-memory performance in 20 dyslexic children aged between 11 and 13 years, compared to matched normal readers. Participants were asked to successively recall four 6-item lists presented orally, 2 lists were comprised of concrete words and 2 lists of abstract words. Participants first recalled one list of each type (random order) and were thereafter instructed to use a mental imagery strategy during presentation of the two remaining lists (random order). Presentation of each list was followed by an interferent task during 20s to limit mental rehearsal. Dyslexic children had comparable performance than normal readers in all conditions, except for recall of abstract words not supplemented by an imagery strategy. The overall effect of word concreteness was significant and comparable in both groups (recall of two additional words), while the mental imagery strategy significantly improved recall only in dyslexic children, and only for abstract words. Thus, active mental imagery may improve working memory performance in dyslexic children, as has been previously shown for other learning strategies, including cued performance, and strategy instruction (Swanson et al., 2009), and thus develop specific working memory components.
When does fast word recognition turn into automatic word recognition: An interference control study that combines lexical decision and the Simon task

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Proficient readers are not only fast readers but also read relatively fluent and automatic. Fluent reading seems especially hard to accomplish for dyslexic readers. Understanding normal development may provide essential insights into the specific deficits involved in dyslexia. This study tracked the development of word recognition to determine when fast word recognition becomes automatic word recognition. We predicted proficient readers’ accuracy and speed during word recognition to be relatively immune to facilitation and interference of a secondary auditory stimulus (small Simon effect). In contrast, we predicted two less proficient groups to respond faster and more accurate during facilitation than during interference (larger Simon effects), suggesting higher attention demands.

We tested 108 children in Grades 2, 3 and 4 with a lexical decision task combined with a Simon task. During lexical decision an auditory stimulus was presented either in the ear congruent to the response hand (Facilitation condition) or the incongruent ear (Interference condition) or in both ears (Control condition). For words, Simon effects on speed were smaller for proficient than for the least proficient readers yet not different from the less proficient group of readers early on in the process. For nonwords, Simon effects on speed were smaller for proficient readers than the other two groups. For both words and nonwords, Simon effects on accuracy were smaller for proficient readers than for less proficient or the least proficient readers. Proficient readers are not only faster but also more automatic than the least proficient readers. Simon effects on speed suggested that less proficient readers were also automatic word readers. However, Simon effects on accuracy indicated otherwise. In sum, during reading development some fast reading entails automaticity but not all fast reading.
Effects of word-length and word-frequency in dyslexic people: Evidenced through a progressive demasking word identification task

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People with dyslexia have difficulties in the phonological/lexical level of analysis, given that dyslexic group showed longer reaction times (RT) to long words and low frequency words compared to age-matched controls in tasks as reading aloud isolated words and lexical decision. The present study compared the performance of dyslexic and non-dyslexic readers in a different experimental paradigm of visual word recognition with speeded identification: progressive demasking task. Also, it examined the word-frequency and word-length effects in Spanish language. The results showed faster RT in word identification for the control group compared to the dyslexic group and a significant effect of frequency in the RT. The effect of word-length was not evident; however, RT were slower for the dyslexic group in the low frequency words and long words. The present study provides the following evidence: 1) progressive demasking task showed the same sensitivity as other tasks of word recognition for factors affecting the early stages of visual word recognition (as frequency effect); 2) the dyslexic group had greater difficulty in identifying words in comparison to the control group, as dyslexic group?s word decoding skills were somewhat below the level of the non-dyslexic comparison group (i.e. increased RT for low frequency words and long words); 3) for both groups, we were able to establish highly reliable word-frequency effects; this is compatible with the view that word-frequency influences a relatively early stage of word processing.
How and when do children misread similar words? Neighborhood frequency effects revisited

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When we read a word, not only the representation of that word but also the representations of its neighbors— all the orthographically similar words— are activated in our lexicon (Grainger et al., 1989). The neighborhood frequency effect is an example of this phenomenon, and it has been deeply studied in adults: words that have higher frequency neighbors are more difficult to identify than words that do not have neighbors of higher frequency (Carreiras, Grainger & Perea, 1997, Davis & Taft, 2005). This effect informs about the word coding mechanisms in the cognitive system of skilled readers. However, there is little evidence about when and how this effect emerges in children who are learning to read. We examined the neighborhood frequency effect in children of 2nd, 4th and 6th grade. In Experiment 1, children were required to name words that had both addition, deletion or transposition neighbors and control words that had no neighbors. In Experiment 2, a lexical decision experiment was run using the same stimuli. In both tasks, only children in 4th and 6th grade were sensitive to neighborhood frequency, with addition neighbors leading to inhibitory effects. Interestingly, this effect was observed in reading times and % of errors in the naming task, but only in % of errors in the lexical decision task. We discuss these findings in terms of the progressive development towards a lexical reading strategy, and the different requirements of both tasks.
Lexical orthographic acquisition: Is handwriting better than spelling aloud?

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According to the self-teaching hypothesis (e.g., Share, 1995), the acquisition of lexical orthographic knowledge is accumulated largely via the process of successful decoding. This acquisition is currently described as the build of links between visual forms and auditory forms of whole words (e.g., Ehri, 2005). However, a growing number of data suggests that a motor component could also be involved in orthographic acquisition (e.g., Cunningham & Stanovich, 1990; Longcamp, Zerbato-poudou, & Velay, 2005; Rapp & Lipka, 2011). One study (Shahar-Yames & Share, 2008) supported the idea that handwriting is a better lexical orthographic self-teaching situation than reading. However, this study couldn’t distinguish the role of the motor component and the role of the short term memory component, both involved during the handwriting task and not during the reading task. The aim of the present study is to determine whether the motor component is involved in the orthographic acquisition process, independently from the short term memory component. Fifth graders had to read new words embedded in short sentences. Each item contained at least one inconsistent grapheme. Immediately after reading, participants were systematically asked to remember items’ orthography. For half of the items, they had to spell the item aloud. For the other half, they had to write the item by hand. One week after, orthographic acquisition was tested with both a spelling to dictation task and a recognition task of the items. Results show a significant effect of the learning condition in the spelling to dictation task only. Items were better remembered when they had been handwritten than when they had been spelled aloud during the learning phase. Results confirm Shahar-Yames & Share results (2008) and suggest that the motor component of orthographic memorization could be more activated during word production than during word recognition.
Orthographic learning, spelling, and reading: The write way to learn?

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Proficient reading is proposed to rely largely on a reader's ability to store printed words in memory and link these representations to phonemes or sounds; developmentally, there is a transition on the pathway to literacy, where children progress from sounding out words to being able to more automatically recognize and spell printed text. This is often seen as a stumbling block to proficient literacy within dyslexia. Developmental theory has described this transition to more rapid word recognition and accurate spelling as being a consequence of orthographic learning. Orthographic learning refers to how longer letter strings and entire printed words are stored in memory along with connections to their respective sound patterns. This research evaluated the proposed links between orthographic learning and emerging reading and spelling skills and also evaluated different aspects of teaching practice that may influence orthographic learning. In particular, orthographic learning proficiency was evaluated within a sample of grade 2 (7-8 year old) students, who were also evaluated on measures of decoding, word recognition, and spelling. New non-words were then taught through spelling practice, with half the students practicing spelling by hand and the others via a computer keyboard. This latter test is especially important given the increased use of computers and software in the classroom. Analyses revealed a prominent role of orthographic learning in explaining reading and spelling skills, although it was not the lone predictor of success in these areas. Further, it was found that both groups of students acquired new orthographic representations through spelling practice. Pre-existing keyboarding skills were found to constrain or facilitate learning within the keyboard-typing practice group. A similar interaction was not found between printing skills and learning within the printing by hand group. These results clarify the role of orthographic learning in literacy and highlight important areas for literacy instruction.
Parallel and serial reading processes in children

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Fluent reading is characterized by rapid and accurate identification of words. It is commonly accepted that such identification relies on the availability of orthographic knowledge. However, whether this orthographic knowledge should be seen as an accumulation of word-specific knowledge in a lexicon acquired through decoding, or as a well-developed associative network of sublexical units is still under debate. We studied this key issue in reading research by looking at the serial and/or parallel reading processes underlying word and nonword reading. Participants were 314 second, third, and fifth graders. The children were administered digit, word and nonword naming tasks. We used latent class analyses to distinguish between readers who processed the letter strings serially or in parallel, based on the correlations of word and nonword reading with serial and discrete digit naming. The two classes of readers were distinguished for both word and nonword reading. The validity of these classes was supported by differences in sensitivity to word and nonword length. Interestingly, the different classes seemed to reflect a developmental shift from reading all letter strings serially, toward parallel processing of words, and later of nonwords. The results do not support current theories on the representation of orthographic knowledge. Rather, the findings would support a model of the reading system that includes initial serial decoding, as well as later parallel activation of phonology from print for all letter strings.
The role of whole-word visual processing on orthographic acquisition: A study on dyslexics with or without visual attention span deficit

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The self teaching hypothesis suggests that most knowledge about the orthographic structure of words is acquired incidentally during reading through phonological recoding. However, recent studies have shown that visual processing skills during reading further contribute to orthographic learning. More precisely, the ability to process the entire orthographic letter string at once during reading appears as a significant factor of efficient orthographic learning, for normal readers (e.g., Bosse, Chaves, Largy, & Valdois, in press). The present study tested this hypothesis on dyslexic children with or without visual attention span deficit (Bosse, Tainturier, & Valdois, 2007). Participants were asked to look at pseudo-words, listen to their oral form and read them. The whole pseudo-word letter-string was available at once for half of the targets and the pseudo-word’s sublexical units were discovered in turn for the other half. Presentation time and total time of processing were controlled. The memorisation of target orthographic forms was assessed 10 minutes after reading. Results are not yet available because the experiment is in progress. The main hypothesis is that results of dyslexics without visual attention span deficit will be equivalent as normal readers, with more orthographic learning when pseudo-words have been seen in their whole. On the contrary, dyslexics with a visual attention span deficit are expected to memorise less items than the others, and to memorise equally items seen under a whole-word presentation and items seen under a sequential presentation.
Orthographic sensitivity and the integration of orthographic and phonological processing in adult dyslexia

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Developmental dyslexia is characterized by reading and spelling deficits which might be attributable to the suboptimal integration of orthographic and phonological representations. Additionally, orthographic sensitivity might be attenuated per se, that is inefficient orthographic processing (if present) might do not relate to phonological deficits. In a large sample of adult readers (N>50) covering a broad range of reading skill (from dyslexic to skilled reading) we investigated the electrophysiological (EEG) correlates of automatic orthographic processing. After performing a behavioural screening procedure measuring word- and sentence-level reading, orthographic knowledge and other reading-related skills (phoneme awareness, RAN), participants were given an implicit reading task in uni- and multimodal (audiovisual) modalities while EEG was recorded. The implicit reading task required the processing of item pairs (words and pseudowords). Items could be same, one-letter different or transposed-letter pairs. The complex pattern of results suggested that poor readers showed more severe deficits if the task tapped on the integration of orthographic and phonological processing, but their brain responses (at least in some readers) also differed in the visual-only condition. However, our correlational analyses focusing on the relationship between behavioural and EEG-measures revealed that the commonly investigated event-related brain components (N170, N270-N300, etc.) should be treated more cautiously and group differences should not be over-interpreted.
Visual cognitive disability without phonological awareness
disability in Japanese speaking children with developmental
dyslexia

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Disability of phonological awareness is one of the main cognitive disabilities of developmental dyslexia in English speaking countries. In Japanese speaking children with developmental dyslexia, most of them have problems both of phonological awareness and visual cognitive disabilities. However, we found four children who showed reading and spelling difficulty with visual cognitive disability and without phonological disability. They are right-handed three boys and one girl from eight to twelve years old. They showed normal general intelligence, receptive vocabulary and phonological awareness according to the scores of Wechsler Intelligence Test for Children, Standardized Comprehension Test of Abstract Words, Picture Vocabulary Test revised, non-word repetition and word repetition in reverse order. In visual cognitive tasks, such as line drawings identification test, Rey-Osterreith Complex Figure Test (ROCFT), they manifested lower scores to compare with Chronological (CA) and Reading Age (RA) matched children as well as lower scores in the accuracy and fluency of Hiragana, Katakana, and Kanji reading and spelling tasks. They showed severer visual cognitive disability compared to children with developmental dyslexia who showed both of visual cognitive and phonological awareness disabilities, and only phonological disability. These results from four children suggested that severer visual cognitive disability alone could cause reading and spelling disability in Japanese writing system.
Visual specialization for words in dyslectic and typically reading children

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The specialization of visual areas for fast processing of printed words plays an important role in the acquisition of reading skills. Differences in the development of these neural processes may be among the deficits underlying developmental dyslexia. The present study looks at the word activation specificity in dyslexic children in 3rd grade by comparing early components of brain potentials elicited by visually presented words or string of meaningless letter-like symbols. The aim is to explore the level of word specific activation after the first two years of reading and, most importantly, how dyslexics and normal readers differ at this stage of reading development. A sample of 40 children with the diagnosis of dyslexia and 20 control readers with ages between 8 and 9 year old were recruited and both behavioral and ERP measurements were taken. Preliminary results show a more pronounced N1 component for words compared to symbols for both groups. In contrast to previous findings, the dyslexic group showed larger left-lateralized and word-specific N1 responses than the normal reading group, suggesting that the interpretation of this early word specific response may be more complicated than previously assumed. The results will be discussed with special reference to the visual features of letters vs. symbols and the relation of the N1 differences with several behavioral measurements will be further examined.
Russian is a language that is characterized by regular orthography to phonology (feedforward) and irregular phonology to orthography (feedback) correspondences. Regularity and consistency can be regarded as two separate dimensions that are difficult to tease apart in English. Feedback inconsistent words in English often contain consistent but unique rimes. On the other hand, in Russian regular words can be either consistent or inconsistent depending on the constituent letters. This provides a powerful tool for experimental manipulation. The aim of this study was to explore the reading of Russian speaking children recently exposed to literacy instruction by testing the effects of word consistency and regularity on learning. Good and poor readers (36 participants in each group) were tested on word reading and spelling tasks. Results from the spelling task show that performance with feedforward and feedback consistent words was at ceiling for both groups. Spelling of feedforward inconsistent words with high feedback regularity was also impaired for all participants. This suggests that the correspondences needed to spell feedforward consistent items are not automatically acquired in the first year of reading instruction. It is hypothesized that learning to read takes time for Russian speaking children because of feedback irregularity in the print. Printed words with inconsistent feedback correspondences are the most difficult to acquire as indicated by impairment in the poor reading group. Interestingly, proficient readers show two distinct patterns of performance with these items - spelling can be competent or relatively impaired i.e. reading without spelling. Characteristics of the dissociated subgroups including their phonological skills and nonword reading abilities show differences in performance providing insight into the underlying reasons for differential patterns of performance. In conclusion, it is argued that feedforward and feedback consistency of words is an important constraint on the acquisition of reading and spelling skills in Russian.
Morphological segmentation and orthographic transparency in typical and dyslexic Hebrew readers: Evidence from brain and behavior

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Background: Current evidence suggests that phonological and morphological processing play a role in typical and atypical development of reading. The dual version of Hebrew script (pointed and un-pointed) and the rich morphology of Hebrew provide an opportunity to learn about the interaction of orthographic depth and morphological richness on reading processes among typical and dyslexic readers in a within-language design. Methods: 21 typical and 20 poor adult Hebrew readers participated in the behavioral study. 18 typical adult readers participated in the fMRI study. Participants read aloud 248 frequent Hebrew nouns manipulating the following variables: morphological complexity (mono-morphemic vs. bi-morphemic (root+ pattern) nouns); phonological transparency (pointed vs. un-pointed; with vs. without a vowel letter); and word length (3 vs. 4 consonants). Results: Behavioral results show greater reliance on morphological decomposition in dyslexic compared to typical readers. Only dyslexics read pointed words slower than un-pointed words. Both groups benefited from an additional consonant or vowel letter in un-pointed words, whereas the opposite was found in pointed words. The findings from the fMRI study in typical readers showed enhanced activation for pointed words in right fusiform gyrus, consistent with the low familiarity of the orthography, as well as in left pars-opercularis and inferior parietal lobule, indicating enhanced orthography-to-phonology mapping and phonological segmentation. For pointed words greater activation was found in bi-morphemic compared to mono-morphemic words in bilateral middle & superior temporal gyri indicating enhanced semantic and phonological processing. Conclusions: Our results suggest that both typical and dyslexic adult Hebrew readers, reading unambiguous words, do not benefit from increasing the orthographic transparency at the cost of reducing orthographic familiarity. In contrast, they do rely (to different degrees) on morphological decomposition, but not necessarily to compensate for missing phonological information.
A close relationship between orthographic representation and morphological processing: The role of orthographic opacity in processing complex words by skilled children and children with dyslexia

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The study we present explored how orthographic modifications to the stems of complex words affect morphological processing in young proficient readers and children with reading disorders. We ran two experiments in which we manipulated orthographic alterations to word stems. In the first experiment a go/no-go task was used to assess the morphological Base Frequency (BF) effect. Two kinds of complex words were employed: those where no orthographic alteration occurs when concatenating the affix to the stem (jardín-jardinero; garden-gardener), and those where the final vowel of the stem must be eliminated when concatenating the affix (piano-pianista; piano-pianist). The results showed significant effects for all three main factors (Group, BF and Orthographic alteration) and for the interaction between BF and Orthographic alteration, with the BF effect significant only in the case of words with no orthographic alterations. In the second experiment a definition task was carried out. In this case, the orthographic alteration involved reducing the diphthong of the stem to a single vowel when concatenating the affix (diente-dentista; tooth-dentist). The results showed significant effects for both factors (Group and Orthographic alteration), with all readers performing worse at defining derived words that had undergone an orthographic alteration. Overall results show that all children benefit from the effect of BF, that children with reading disorders perform and score below skilled children, and that morphological processing is affected by the orthographic alterations in both proficient readers and children with reading disorders. The presentation is aimed to present these data and further discuss the role played by the orthographic opacity/transparency of stems in processing complex words by skilled children and children with dyslexia.
What the orthographic similarity of phonological primes can tell us about the time course of orthographic and phonological code activation in transparent languages

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The ability to quickly integrate orthographic and phonological codes is crucial for the development of reading proficiency. The exact nature of this integration process is assumed to depend on characteristics of the language concerned. Research on the time course of orthography-phonology integration during proficient visual word recognition in different languages may enhance our understanding of both skilled reading and reading deficits such as dyslexia. In opaque orthographies, activation of orthographic and phonological codes have been shown to follow distinct time courses. However, it is unclear how orthography and phonology are accessed in more transparent orthographies. Therefore, we used masked priming in a lexical decision task to identify the time course of orthographic and phonological priming effects in the transparent Dutch orthography. Results showed strong and early appearing orthographic priming effects, yet no additional phonological priming. We suggested that the strong interconnectivity between phonology and orthography in the transparent Dutch orthography had resulted in intertwined orthographic and phonological influences from the orthographic prime, leaving little room for additional effects of the phonological prime. To test this, we conducted a second experiment and systematically compared phonological priming effects between primes with high and low orthographic similarity with the target. We replicated the finding from the first experiment: the orthographically similar phonological primes provided no additional facilitation compared to orthographic primes. In contrast, for targets with orthographically dissimilar phonological primes, phonological priming effects appeared early in the word recognition process, yet lagged slightly behind the effects of orthographic primes. This indicates that readers of a transparent orthography can access phonological codes automatically and independently from orthographic codes. However, the strong interconnectivity between phonology and orthography in transparent orthographies results in intertwined orthographic and phonological influences when readers read the words with consistent grapheme-phoneme correspondences that are typical in their language.
Numerous studies in typically achieving and impaired children put forward the impact of orthographic transparency on reading and on the underlying deficits in dyslexia. It is assumed that reading deficits are less severe in transparent languages such as Spanish whereas difficulties are harder to compensate in opaque ones such as English. However, less is known on bilingual children who learn to read two languages with different orthographic systems in parallel. Here, we describe the case of GF, a 9; 9 year-old french-occitan bilingual child with developmental dyslexia. His school only provides classes in Occitan from the age of 3. Reading is first learnt in Occitan (a quite transparent language) then in French (a deeper orthography). We built lists of French and Occitan words and nonwords in reading and spelling under dictation tasks. We analysed the reading and spelling results (errors and reaction time) in both languages to observe whether 1) one language is more impaired than the other 2) error patterns are language specific or might reflect a cross language transfer. We compared the results to these of AC, a 9; 8 year-old typically achieving child who belong to the same school as GF. In the reading tasks, GF had more difficulties in reading Occitan nonwords (6/10 errors) compared to the other conditions and to AC. The spelling under dictation task elicited much more errors (21/40 and 16/40 for GF and AC resp.), especially in Occitan. In French, we mainly observed orthographic errors, on words spelling. In Occitan, errors suggest that phoneme-grapheme conversion rules are not to well known. French rules are preferred. To conclude, despite the fact that reading was first taught in Occitan, French is better processed and influences reading and spelling in Occitan. The impact of orthographic systems involved and language use context will be discussed.
Language profiles in children with ADHD and in children with reading disorder (RD)

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Attention deficit hyperactivity disorder (AD/HD) and RD are the two most prevalent neurodevelopmental disorders of childhood, and high rates of comorbidity have been reported for both disorders. This large scale population-based study aimed to explore whether children with symptoms of AD/HD, children with symptoms of RD, children with symptoms of both AD/HD and RD and a control group could be differentiated from each other regarding different aspects of language; phonology, expressive language, receptive language and pragmatics.

Method: Out of a sample of 5672 children aged 7-9 years four groups were derived based on the results of a screening questionnaire distributed to teachers and parents of the children; children with RD (N=332); children with ADHD (N=169); children with AD/HD + RD (N=121) and a control group (N=5050). Results: All groups differed significantly on phonology and expressive language; the ADHD+RD group being most severely impaired, followed by the RD group, the ADHD group and the controls. On receptive language significant differences were also revealed between all groups, with the ADHD+RD group being most impaired, here followed by the ADHD group, the RD group and the control group. Regarding pragmatics a somewhat different picture was found; although the ADHD+RD group was most severely impaired and the control group was not, the difference between the ADHD group and the RD group did not reach significance on this item (p=.02).

Conclusions: In sum these findings support findings from clinical samples pointing to a considerable rate of language impairments both in children with symptoms of AD/HD and in children with symptoms of RD. Although children with ADHD and children with RD share many symptoms of language impairments, they can be differentiated from each other regarding some aspects of language.
Links between reading precursors and early numeracy skills in preschoolers

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The aim of this study is to evaluate the role of reading precursors in preschoolers' early numeracy skills. Eighty-one Italian preschoolers (mean age 56.9 months, range 47 - 65 months; 54.3 % females) were administered with two screening batteries to evaluate precursors of school learning abilities. In particular, phonological awareness, non-word repetition and letter knowledge were analyzed as reading precursors. Furthermore, precursors of math abilities such as quantity comparison, counting, size seriation, semantic knowledge of digits (digits recognition, digits reading and association between digits and quantities) and visual-spatial memory were examined. A composite score was obtained considering children's performance on reading precursors. It was used to classify children with poor (< -1 SD; n = 8), medium (between -1 and 1 SD; n = 65) and high (> 1 SD; n = 8) performance. Then, a MANOVA was run to analyze differences in early numeracy skills between the three groups. Results showed a significant effect of Reading precursors group on counting and semantic knowledge of digits, with a linear improvement between the three groups. On the contrary, quantity comparison, size seriation and visual-spatial memory were similar in the three groups. The practical and theoretical implications, in particular for preschool programs, are discussed.
Development of syntactic awareness of Chinese primary school children: The relative contribution of morphosyntactic skill and word-order knowledge to Chinese reading comprehension

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The present study attempted to examine the development of contribution made by individual syntactic measure in explaining reading ability across age among Chinese school-aged children in Hong Kong. Study 1 is a cross-sectional study in which we administered two syntactic tasks (morphosyntactic correction and word-order correction) and Chinese reading comprehension measure to 266 Hong Kong Chinese first to sixth graders. In junior grades, morphosyntactic and word-order correction each contributed a significant amount of unique variance to reading comprehension in Chinese, with age, nonverbal IQ and Chinese word reading statistically controlled. When proceeding to later grades, only morphosyntactic correction was uniquely associated with Chinese reading comprehension among third and fourth graders, while word-order knowledge became the only unique correlate of Chinese reading comprehension in Grades 5 and 6. Study 2 is a 3-year longitudinal study assessing the predictive power of early syntactic performance on later reading success at two levels (sentence- and passage-level) among Chinese children from Grade 2 (Time 1) to Grade 4 (Time 3). Results showed that after controlling age, nonverbal IQ, Chinese word reading, and the auto-regressor, both Grade 2 word-order correction and Grade 2 morphosyntactic skill remained unique longitudinal predictors of sentence comprehension one year later. However, Grade 2 word-order knowledge did not explain significant unique variance on Grade 3 sentence comprehension once Grade 2 morphosyntactic skill was controlled. On the passage level, Grade 2 word-order correction, but not morphosyntactic correction, uniquely predicted passage comprehension in Grades 3 and 4 after taking into account the control variables and the auto-regressor. The findings collectively revealed a stronger association between morphosyntactic skill and sentence comprehension, whereas word-order knowledge is more related to passage comprehension, implying that different syntactic measures may be sensitive in tapping syntactic skill at different age and reading-level.
Grammatical awareness and grammatical spelling: Comparison of children with and without dyslexia

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Grammatical awareness can be defined as an explicit knowledge about the grammatical attributes of language. It can be viewed as composed of two abilities: syntactic awareness and morphological awareness. So far, the literature has focused on morphological awareness and showed only one discrepancy between dyslexic children and chronological age matched children whereas no difference have been found between dyslexic children and reading age matched children. The present study aimed to compare syntactic awareness (i.e., identification of the grammatical subject of the sentence) and grammatical spelling (i.e., subject-verb agreement) among children with and without dyslexia. Twenty dyslexic children were compared to 16 grammatical spelling age matched children. Two tasks were administrated to participants: 1) a grammatical spelling task where children had to listen to 24 sentences and to fill them in under dictation with nouns and verbs; 2) a syntactic awareness task where children had to identify the grammatical subject of the same 24 sentences. The second task was done after another task and participants were asked to use a different colour pen. Four types of sentence structures were presented and the sentences were controlled for length, level of acquisition of lexical spelling and word frequency. The results showed that children with dyslexia were less accurate at identifying the grammatical subject of the sentence than spelling age matched children, even though both groups of participants correctly marked the same number of verb agreements. These findings suggest that children with dyslexia have a specific deficit of syntactic awareness that can explain their difficulties in grammatical spelling. This can be useful to plan how these abilities can be better developed at school or during a treatment.
Phonological, morphological, and orthographic factors in spelling of children with inconsistent speech disorder

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Background: The spelling outcomes of children with isolated speech disorder (i.e. without accompanying language impairment) are variable. Phonological awareness and morphological awareness, two important contributors to spelling development, have been identified as predictors of literacy achievement within this population. However, the contribution of orthographic knowledge, a third aspect of linguistic awareness that is known to influence spelling development, has not been previously examined within this population. This study examined the contribution of phonological awareness, morphological awareness, and orthographic knowledge to word-level literacy development in children with inconsistent speech disorder and their typically developing counterparts.

Methodology: 38 children with inconsistent speech disorder (i.e., inconsistent pronunciation errors on repeated productions of the same word) and 48 children with typical development aged 6 to 8 years participated in the study. The following assessment areas were evaluated within the cross-sectional design: non-verbal intelligence, receptive vocabulary, receptive and expressive morphological awareness, orthographic pattern awareness, phonological awareness, nonword reading, word recognition, and spelling (including linguistic analysis of spelling errors).

Results: A comparison between the performance of each group in all the measures will be conducted. Regression analysis will be employed to identify whether the three aspects of linguistic awareness (i.e., phonological awareness, morphological awareness, orthographic knowledge) predict unique variance (above and beyond other measures) in the reading and spelling scores the speech disordered and typical groups.

Conclusion: The results will be discussed within the multiple deficits model (Pennington et al., 2009) and the general linguistic awareness hypothesis (Apel & Lawrence, 2009). Educational implications will be explored.
It didn't say that: Teachers' knowledge and ability to foster inference-making skills

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Studies of basic language constructs have shown positive correlations between teacher-knowledge and students' reading ability. Fewer studies have examined teacher-knowledge of comprehension, including one crucial component, inferencing. We investigated teachers' self-perceptions and understanding of reading comprehension, and explored possible links to their ability to foster inferencing-skills. Elementary teachers (N=70) were surveyed about their self-perceptions and their comprehension knowledge. Explicit knowledge included identifying subtypes of questions. Literal questions focused on either Main Ideas, dealing with the gist of the story, or Details. Inference questions were based on textual evidence, but required the reader to use background information to supplement answers that were not overtly stated. Causal Inferences explained how/why events occurred. Informational Inferences enriched the characters and the setting. Understanding the Main Ideas and Causal Inferences are most critical for comprehension. The survey showed that teachers' explicit comprehension knowledge was low (M=.45), yet they perceived themselves as 'very good' at 'teaching reading comprehension' and 'inferencing'. This pattern of poor calibration between self-ratings and ability, replicates many studies of teacher knowledge. Encouragingly, teachers who rated themselves high at 'fostering a love of reading' were more knowledgeable about popular young-adult literature (ART-Y) and had higher explicit comprehension scores. Teachers were also given a passage from a popular youth novel and asked to generate comprehension questions. Sadly, the most frequently asked questions focused on the least important information for deep comprehension: literal-details. However, teachers fell into one of two patterns, those who wrote literal-detail questions were least likely to write inference-questions. Moreover, teachers with more explicit comprehension knowledge in Grades 4-8, (where inferencing-skills are a main instructional focus), were most likely to write causal inference questions (and ask fewer literal-detail questions). Therefore, teachers' explicit knowledge may be an important contributing factor to fostering children's inferencing ability and ultimately, to improving reading comprehension.
The effect of parents’ literacy skills and children’s preliteracy skills on the risk of dyslexia

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Which children go on to develop dyslexia? The combination of investigating child characteristics and family characteristics sheds light on the constellation of risk factors that can ultimately lead to dyslexia. We present a longitudinal study following the progress of children with and without a family history of dyslexia. The study examines plausible preschool risk factors and their specificity for predicting reading development. Furthermore, it goes beyond testing the effect of having a parent with dyslexia to quantify the cognitive risks passed on from both parents to their offspring. Participants included at-risk children with (n = 50) and without (n = 82) dyslexia in Grade 3 and controls (n = 64). First, we found impairments in phonological awareness, rapid naming, and letter knowledge in at-risk kindergartners who later developed dyslexia, and mild phonological awareness deficits in at-risk kindergartners without subsequent dyslexia. We also examined the specificity of these preliteracy skills. Although these skills were also related to later arithmetic, associations with later reading were stronger. Second, the literacy environment at home was comparable among groups. Third, literacy skills of both parents were related to their offspring’s reading skills. Children from families in which both parents experienced literacy difficulties were 2½ times more likely to develop dyslexia than children from families with only one affected parent. This suggests that at-risk children who do and who do not develop dyslexia differ in genetic predisposition. Intervention can best be targeted at kindergartens with the highest liability, which are those who do poorly on preliteracy tasks and whose parents have literacy difficulties. Literacy abilities of parents might be viewed as indicators of their offspring’s liability for literacy difficulties, since parents provide their offspring with their genetic and environmental endowment. We propose an intergenerational multiple deficit model in which both parents confer cognitive risks.
A self-report questionnaire on reading-writing difficulties for adults in Spanish (ATLAS)


Universidad de Málaga (Spain)

In this paper a self-report questionnaire on reading-writing difficulties for adults in Spanish (ATLAS) is presented. Two studies were carried out to determine the validity and reliability of ATLAS. The first study was aimed to select the critical items and to assess their reliability and discriminability. In the second study the assessment reported through the answers to the questionnaire was contrasted with the results of psychometric tests. Results showed that (a) items were suitable descriptors for adult difficulties, (b) there were significant correlations between self-report scores and reading measures, and (c) the items discriminate between good and poor readers. The results of this study demonstrated that ATLAS is a reliable tool to screen adults with reading difficulties. As a further advantage, ATLAS is an easy-to-use and time-saving instrument.
A comparison between classroom teachers' beliefs about spelling and their instructional practices

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Purpose: This study aimed to examine teachers' reported spelling assessment and instruction practices. Analysis of the match between teachers' theoretical beliefs about spelling and their reported pedagogy was conducted to elucidate factors that may support or impede the use of evidence-based teaching strategies in the classroom. Method: An electronic survey was completed by 405 randomly selected (stratified by region and socioeconomic status) elementary school teachers. The survey examined the following areas: Spelling assessment, spelling instruction, beliefs about spelling, preparing teachers to teach spelling, and teachers' perceived strengths and weaknesses of their spelling program. Results: There was large variability in spelling assessment and instructional practices across teachers. Most respondents reported implementing some aspects of a developmental approach to spelling instruction through analysis of children's spelling errors (64%) and/or individualization of the spelling program (60%). There was a large dissociation between teachers' beliefs about spelling and their frequency of use of specific instructional practices associated with those beliefs (e.g., phonological awareness, orthographic knowledge). The mismatch between beliefs and reported practice appeared to be due to lack of professional knowledge regarding implementing explicit spelling instruction and finding time to teach spelling within the curriculum. Conclusions: Increasing teachers' knowledge about language structure, practical implementation of key assessment and instruction activities, and the links between spelling and other areas of the curriculum are important factors in improving spelling pedagogical practices.
The impact of teacher competence on Individual Educational Plans for children with reading difficulties


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In Sweden, an increasing number of children are defined as having some form of difficulty in school. A majority of them have reading problems. In a meta-analysis conducted by the National Reading Panel (2000), explicit instruction in phonemic awareness, phonemic decoding skills, fluency, construction of meaning, vocabulary, and guided reading were found to signify effective reading instruction. For children with reading difficulties, the same components of instruction are needed, but have to be even more intensive, more explicit, and carried out in small groups or in one-to-one tutoring (Foorman & Torgesen, 2001). The hypothesis in the present study is that the knowledge about the structure of language among teachers is of critical importance for the design of the reading interventions. However, Moats (2009) argues that teachers’ knowledge about phonology, morphology and orthographic rules is too low. According to the Swedish legislation, a pupil shall be given remedial tuition if there is an apprehension that the educational targets will not be achieved. An Individual Educational Plan [IEP] of the special support should be drawn up in consultation with the pupils and their parents. The aim of the present study is to investigate the relation between teachers’ actual knowledge of the structure of language, as well as their educational background, and the quality of the pedagogical interventions planned in the IEPs. The IEPs (N=150), which comprise one part of the empirical material are gathered from 61 teachers in 11 municipalities in Sweden. The other part comprises a teacher (N = 61) test concerning the structure of the Swedish language. Preliminary analyses indicate a large variation of the quality between IEPs including the assessments of educational needs. The overall question is how the interventions are expressed in the IEPs depending on kind of difficulties, and to what extent they will mirror teacher competence.
The effects of a professional development model to enhance early childhood teachers' storybook reading

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Purpose: Phonological Awareness (PA) is an important component of emergent literacy development. This study examined the effectiveness of a professional development programme in promoting the use of PA and print related cueing by Early Childhood Teachers (ECTs) during storybook reading. Method: 17 ECTs participated in a 90 minute session focused on building their PA knowledge and received up to two hours of in-class coaching (over 10 weeks) to facilitate the implementation of PA and print related cueing during shared storybook reading. The effectiveness of the professional development on ECTs' skills was established by comparing their reading style at pre, mid and post-intervention. Reading style was established by conducting video-analysis which coded ECTs’ utterances during shared book reading into three categories: Language (i.e., commenting, questioning, integration of background knowledge), Print Referencing (i.e., pointing to text, letter sound relationships, text change, and phonological awareness) and Behaviour Management. The impact of the intervention on the PA of 16 children (aged 4;2-4;6) was monitored by comparing PA performance on experimental and standardized measures pre and post-intervention. Results: Preliminary analysis showed that ECTs used low levels of ‘print referencing’ cueing during storybook reading at pre-intervention. Coding of the ECTs’ post-intervention data is underway and change will be explored through statistical analysis. The children made significant gains in standardized scores in syllable awareness (p=.005), rhyme awareness (p=.005), and alliteration awareness (p=.009) across the study. Conclusion: This study found wide variation in how ECTs read storybooks and that a professional development model that includes in-class mentoring is an effective method to increase the amount of print referencing and PA cueing during preschool storybook reading. Integration of PA activities associated with storybook reading appeared to accelerate the children's PA skills.
Experts` perceived characteristics of reading disability in the context of Latvian orthography

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Latvian is specific language from narrow Baltic language group with rather high grapheme-phoneme correspondence. We know a lot about characteristics of reading disability (RD) in opaque English and other transparent orthographies, but there is no evidence about particularity of characteristics of RD in Latvian language. This study was conducted to find out, what characteristics of RD experts perceive as typical in the context of Latvian orthography. The total sample consisted of 56 experts (aged 25 to 60; 100% women; mean work experience with RD=15.76 years; SD=7.60) working in the areas of primary education, psychology, and speech therapy. In the first stage of the study we interviewed two experts and defined the characteristics of RD. Adding extra characteristics mentioned in the theory, we developed Experts’ Perceived Characteristics of Reading Disability (EPCRD) questionnaire with 75 characteristics yielding 11 categories (e.g., decoding, reading fluency, visual-spatial perception). In the second stage EPCRD was offered to five prominent experts in the field. Experts assessed characteristics in 4-point Likert-type scale (where 1- is not typical at all, but 4- is quite typical). Characteristics evaluated with 3.60 and higher (N=36) were considered as typical and EPCRD was restructured in seven categories. In the third stage 36-characteristic EPRDC was given to 49 experts. The results indicated that all 36 characteristics were evaluated as considerable (M>2.63). The most typical were: a lot of spelling mistakes writing self composed sentences (M=3.88, SD=.33) and reading more slowly than most of the peers (M=3.79, SD=.46), while the least typical was: good reading comprehension despite of insufficient fluency and accuracy (M=2.63, SD=.70). The operationalization of the characteristics is also discussed. This expert study formed a basis for the empirical study, where experts’ perceived typical characteristics will be examined in the sample of Latvian primary school children with RD.
An intervention model based on daily monitoring progress for students in first grade: Improving reading skills beyond the tail

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Currently there is a great interest in developing effective methods for teaching reading that help all children acquire adequate reading skills. The present study was designed to assess the effectiveness of an intensive tutorial intervention designed to develop and improve the literacy skills of both normal readers (kids learning fine in regular classrooms) and low-performing first-grade students. The sample comprises 853 Catalan-speaking children who were enrolled in first grade during the 2011-2012 school years in Catalonia. The classrooms participants were randomly assigned to experimental or control group. All children were screened to determine initial status for reading. Children with lower scores in reading fluency variable were assigned to low-performing group and the rest to the normal readers group. Experimental group received a two tiered model of intervention system. This Response to Intervention program included a primary prevention for all the students of the experimental group and supplemental intervention for students identified as low performers for reading difficulties. Daily monitoring progresses were used to decide if the child continued receiving an intervention in two levels or only one. Results showed that children of the experimental group, both low-performing and normal readers, increased significantly more in words, non-words and text reading than control group.
Cognitive models of reading proposed that item-specific knowledge is necessary for irregular word reading (SEW, YACHT). Whereas item-specific knowledge is lexical (whole-word forms) in the Dual Route Cascaded model (Coltheart et al., 2001), it is semantic in the triangle model (Plaut et al., 1996). Neuroimaging contrasts are often confounded by difficulty, familiarity, and word meaning and, as such, have not discriminated between these possibilities. This fMRI experiment used an artificial language to avoid these confounds and delineate the neural systems supporting irregular and regular word learning. Twenty-two adults learned to read 24 new words written in novel symbols, whilst in an MRI scanner. Some words were regular - all symbols had one pronunciation, some words were irregular - vowel symbols were pronounced differently in different words. Regular symbols occurred in 8 (high frequency) or 4 items (low frequency). Learning involved interleaved training (see word-hear pronunciation) and testing (read words aloud) phases, and was followed by generalization to untrained words. Participants learned the trained words (regular high/low frequency-83%, irregular-73% correct) and generalized their knowledge to untrained words (70% correct). Activity in left occipitotemporal (visual-form processing) and parietal (spelling-sound processing) cortices was greater during irregular than regular word learning. However, this was also true for regular words containing low relative to high frequency symbols. In contrast, activity in left inferior frontal gyrus was greater for irregular words than either type of regular word. When confounds of difficulty, familiarity, and meaning are removed, irregular words do not engage brain regions representing visual form more than regular words. Parietal regions involved in mapping from spelling-to-sound are engaged when these mappings are either infrequent or irregular. Inferior frontal cortices are involved in resolving the phonological conflict associated with the multiple competing pronunciations available for irregular words, as embodied in both the DRC and triangle model.
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